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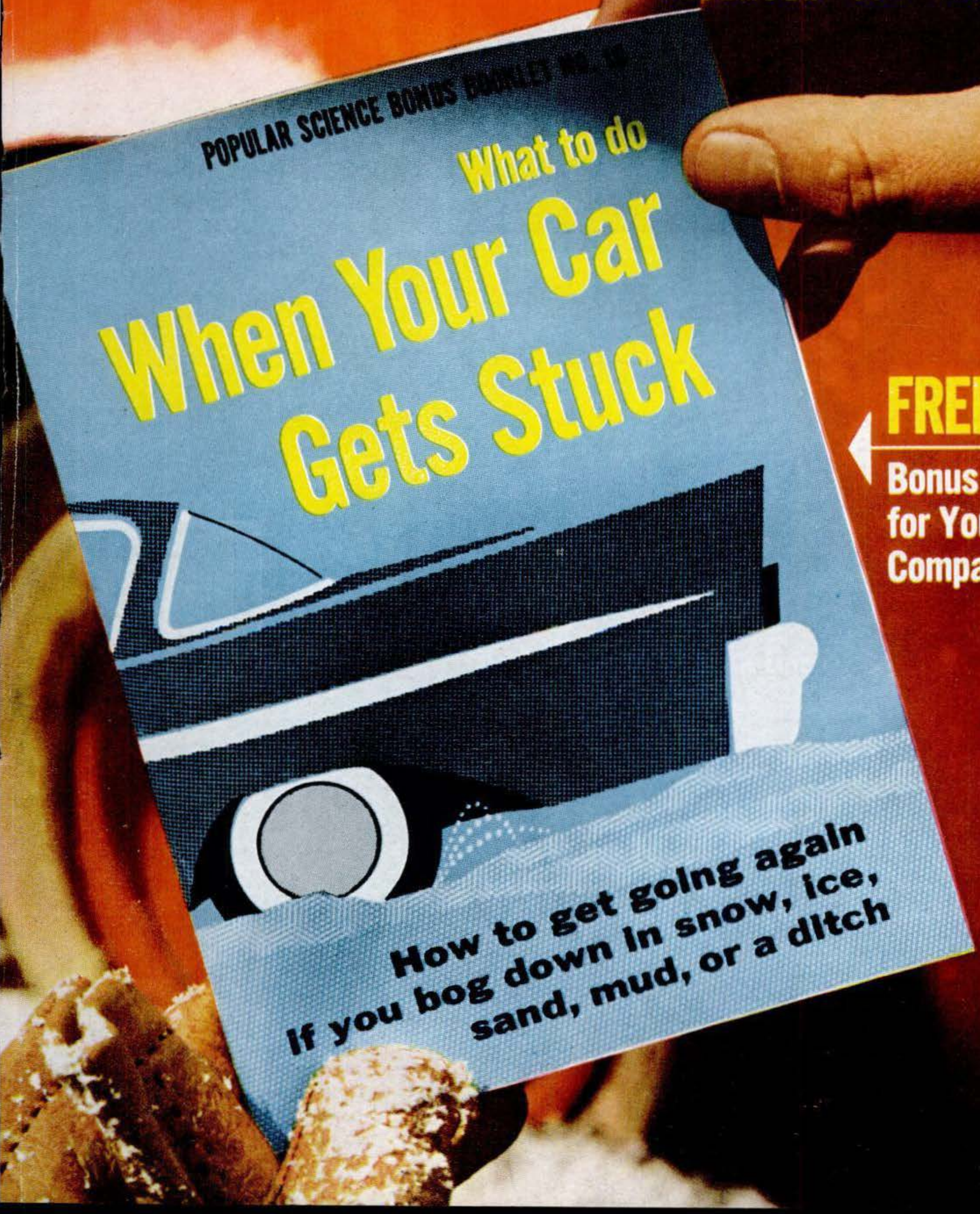

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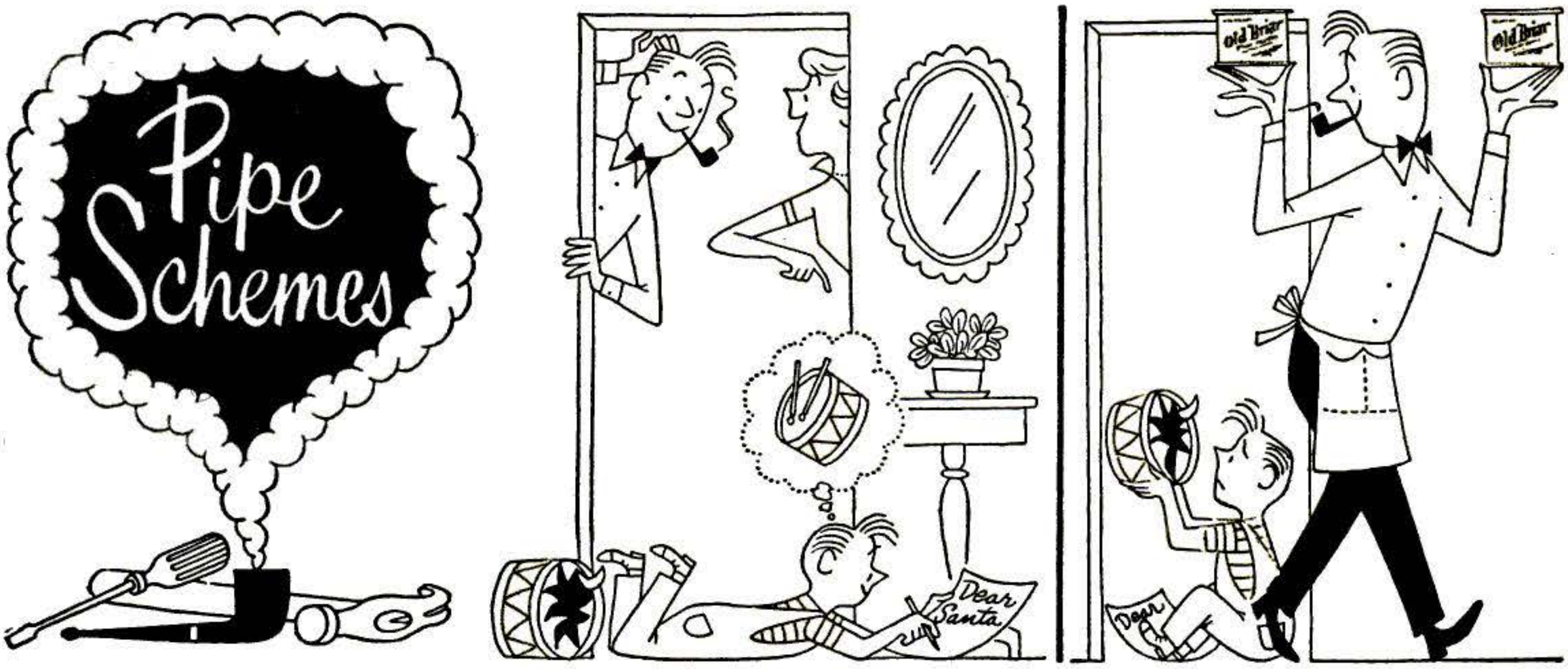

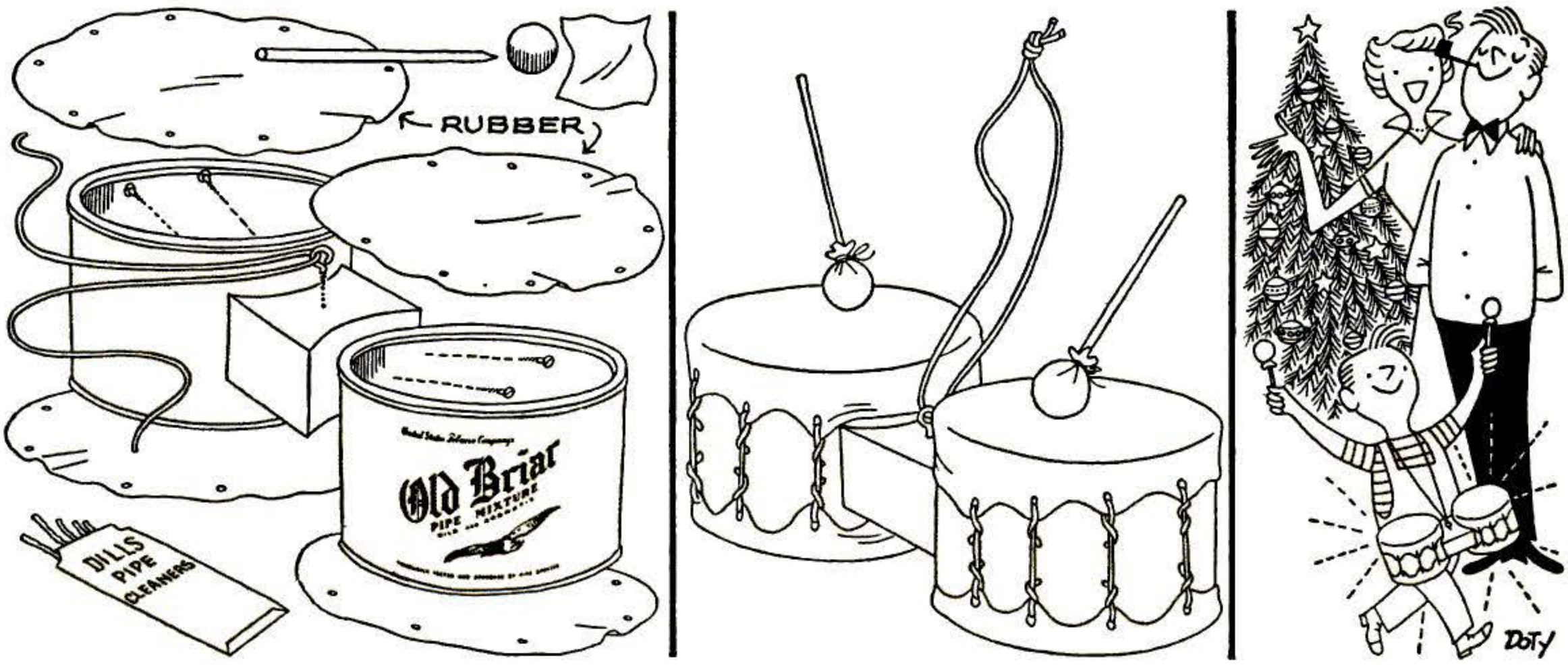

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Founded in 1872 Vol. 177 No. 6 *Mechanics and Handicraft* REG. U. S. PAT. OFF.

Popular Science

December, 1960

Cover photo by R. D. Borst and W. W. Morris

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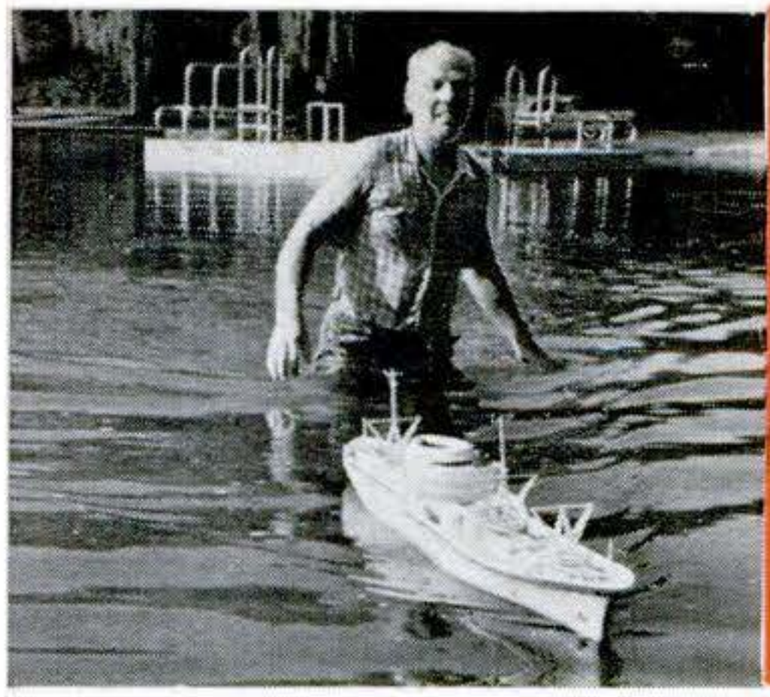

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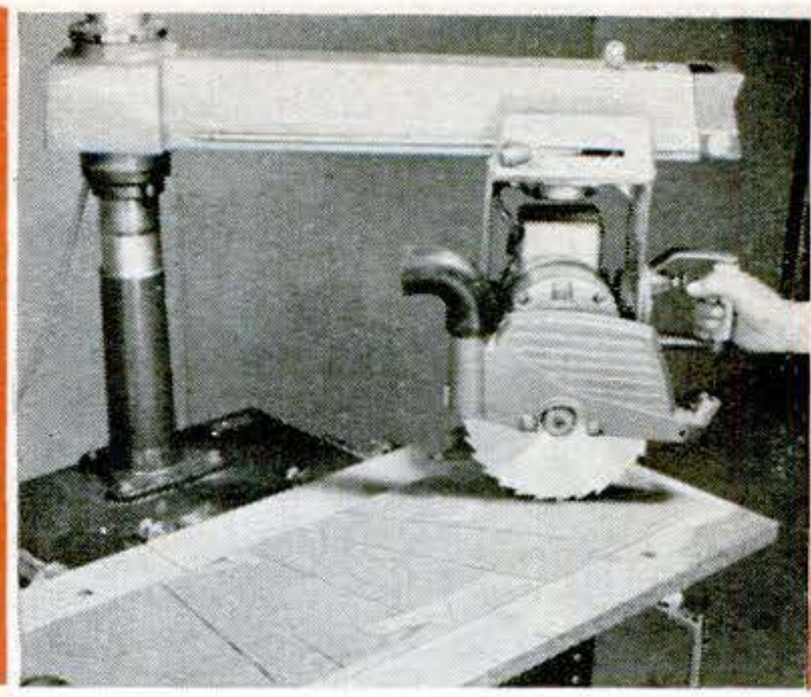

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PS Readers

TALK BACK

What Price Russian Cars?

IN AUGUST ["Ivan Buys a Car in Russia"] you list the cost of a Moskvitch at 25,000 rubles and the cost of a Volga at 40,000 rubles. But in Apr. '59 you listed the cost of a Moskvitch as 8,000 rubles and 16,000 rubles for the Volga.

Does the USSR have inflation also, or did you goof?

MARK SETTERBERG, Houston, Tex.

Writer Walton stands by his figures of 25,000 and 40,000 rubles as the prices to Russian buyers at the time he was in that country. To get foreign exchange, exhibit its industrial growth, and gain influence abroad, the Soviet Union exports cars at lower figures than its own people can buy them for. Actually, the USSR does have inflation—a natural result of more currency than goods to buy with it.

More About the Orient Buckboard

AMONG the antique cars in my Pikes Peak Ghost Town is a 1903 Orient Buckboard like those your readers wrote about in September. The four-hp. air-cooled motor is mounted over the rear wheels. The seat resting on wood slats not only gives the car a buckboard appearance but a buckboard spring effect. It is guided by a steering tiller. Weight of the car is only 350 pounds.

This Orient attracts about as much attention as any antique or classic car in my collection, and it makes for rather interesting comparison with present-day karts. I believe another Orient Buckboard is on display in the Ford Museum at Dearborn, Mich. There are a few in the hands of private collectors in various parts of the country.

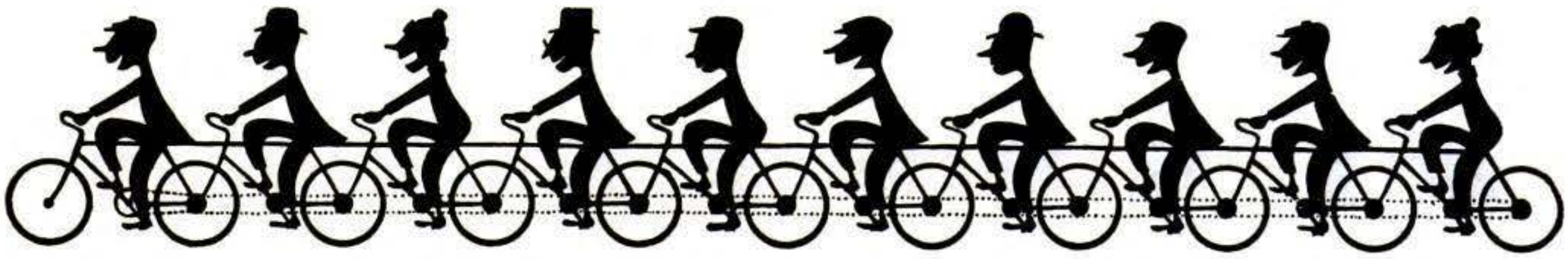
BYRON L. AKERS, Colorado Springs.

. . . WHEN I read Mr. Fry's letter I looked up the car he described in my auto books. One fact not so far mentioned is that the Waltham-Orient was one of 54 new-make cars to be put on the road in 1900.

EDDIE F. HEATH, Mount Olive, N.C.

. . . FROM 1901 to 1906 or 1907 the Orient Buckboard was manufactured in Waltham, Mass., by a company owned by Charles Metz.

Prior to this, Mr. Metz manufactured the Orient motorized Tri-cycle and Quadra-cycle using the imported De Dion gasoline engine. This operation stemmed from his original company, which manufactured the Orient bicycle and also the longest bicycle ever made. This was a 10-man bicycle weighing 305 pounds. It



NEXT MONTH

EXTRA PAGES for winter workshop enthusiasts— *a dozen or more pages crammed with useful and decorative projects, still more extra pages filled with news about home workshop tools, a free blueprint showing how to build a shop vacuum cleaner, shop advice from experts. All in the January issue.*

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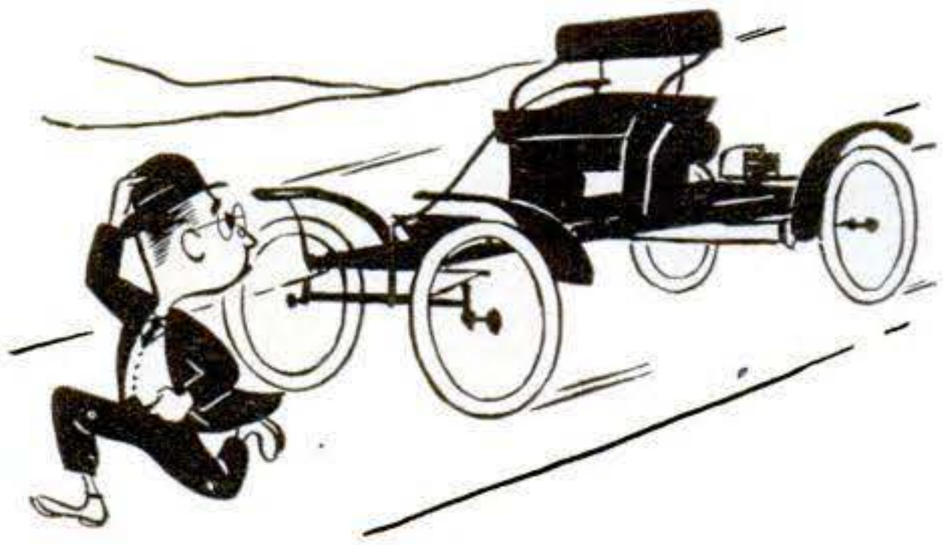
was 23 feet long and capable of over 40 miles per hour. It was manufactured about 1898.

Following the demise of the Orient Buckboard, Metz made a car called the Waltham for several years. Then, in 1909, he began manufacture of the Metz, a friction chain-drive auto. The first models used a two-cylinder, air-cooled engine; but from 1912 through 1921, most of them had a four-cylinder, water-cooled engine. The last car made, before the break-up of the company, was the Waltham Big Six, in 1921-22.

FRANKLIN B. TUCKER, W. Caldwell, N.J.

. . . THE Buckboard had only one speed forward. If you wanted to reverse, you got out, went to the front, and pushed it back. If you were on the



"down" side of a hill, this was somewhat difficult. If you were on the "up" side, it was liable to run away from you.

CHARLES E. AMES, Stoneham, Mass.

. . . MAYBE you'd like to pass on these specs on the Buckboard:

Frame and body—wood
Wheel base—80 inches
Tires—26 x 2½
Gas capacity—3½ gallons
Motor—air-cooled, one-cylinder
Horsepower—4
Transmission—friction disks
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Jump spark—dry batteries
Double-side chain drive
Price—$400 (without canopy)

ALFRED J. PROVOST, Cohoes, N.Y.

The Most Powerful Transmitter

I WAS pleased—as will be all old-time radiomen—that "The World's Most Powerful Transmitter" [Sept.] will use the call letters NAA. These were originally assigned, pre-World War I, to the Navy's

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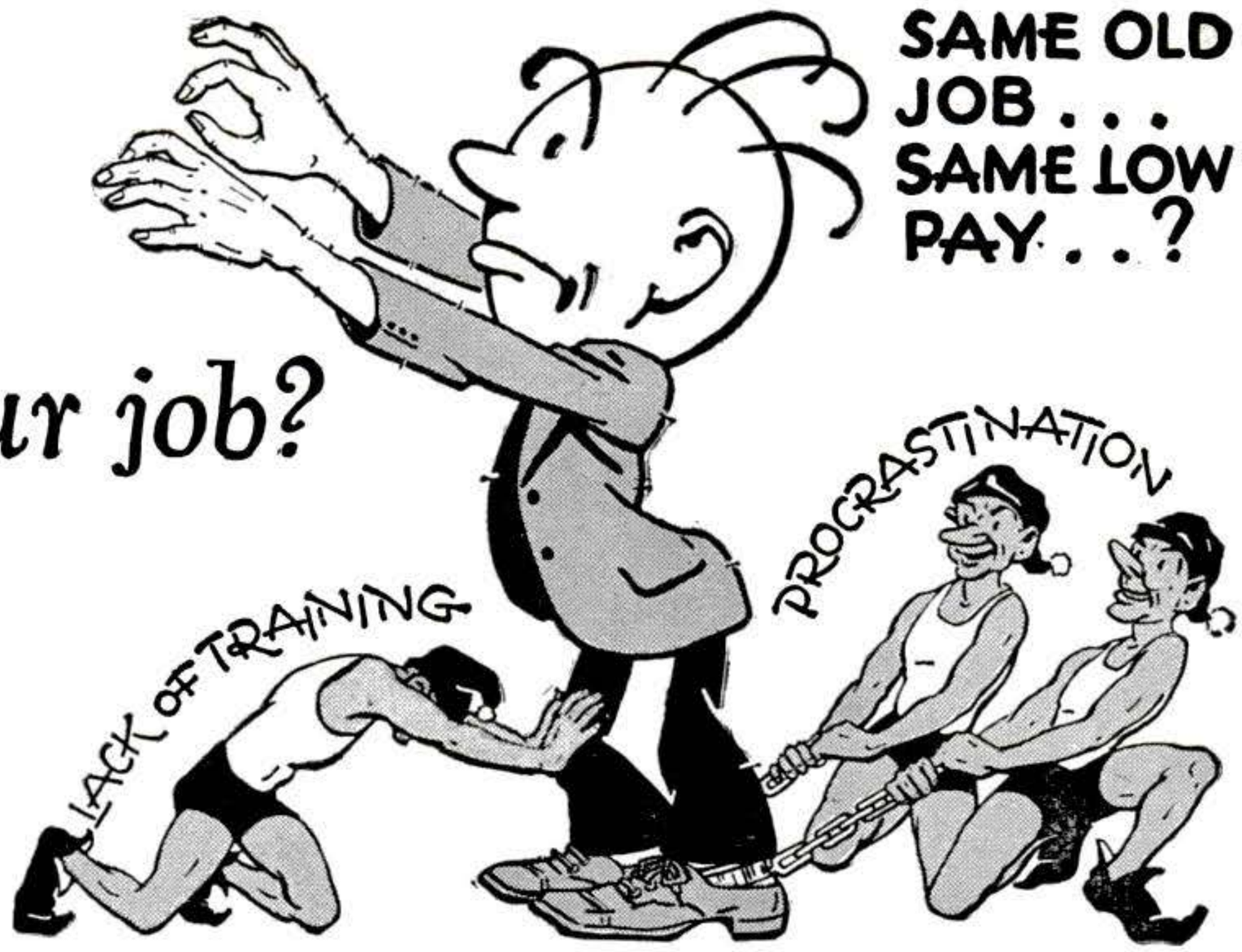
Are You "STANDING STILL" *on your job?*



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famous Time-Tic station at Arlington, Va. From here came the musical spark note so familiar to professionals, as well as amateurs listening in on their crystal-detector sets to get the noon or 10 p.m. time signal.

Technically, the new NAA sounds like a beautiful piece of long-wave CW engineering.

But one thing disturbs me: If, as the writer points out, launching sites of land-based ICBMs could be "sitting ducks" for enemy attack, wouldn't this trigger station for Polaris-carried missiles be an equally vulnerable target?

W. L. JEPSON, Los Angeles.

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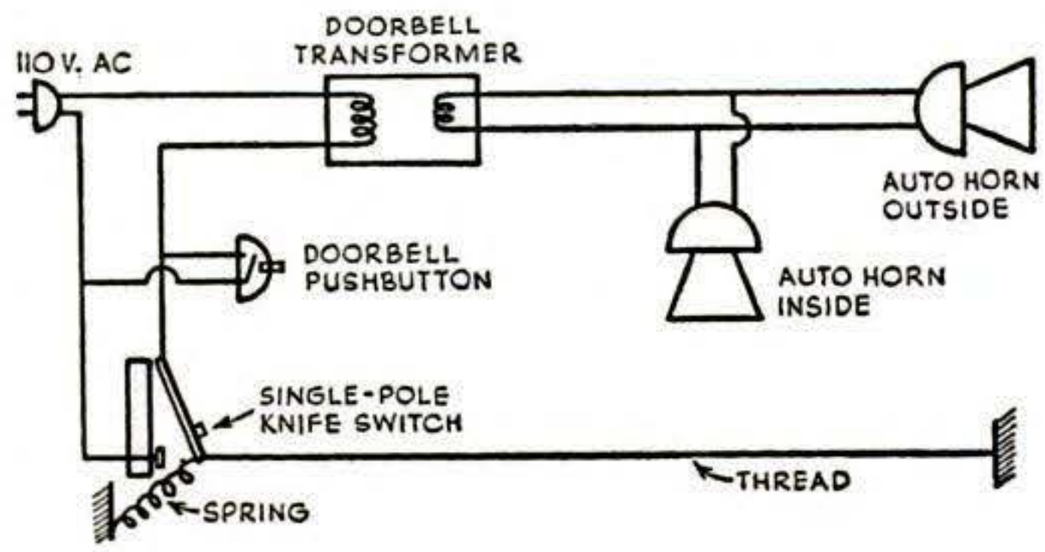
A great job.

ARTHUR ROBERTS,
WXLW, Indianapolis.

Horns to Scare Burglars

THE letters on burglaries [Aug.] prompt me to tell you of my own defensive measure—an efficient but inexpensive alarm system. Made from a toy transformer, a couple of junkyard auto horns, an SPST knife switch, and a doorbell switch, it cost me $7.

The doorbell switch goes on the headboard or rail of your bed. The knife



switch is mounted on the stairway or in a doorway. When the thread is broken the spring closes the switch. Hooked up in this manner, the transformer does not use any electricity until the switch is thrown. Result: no cost.

CONTINUED

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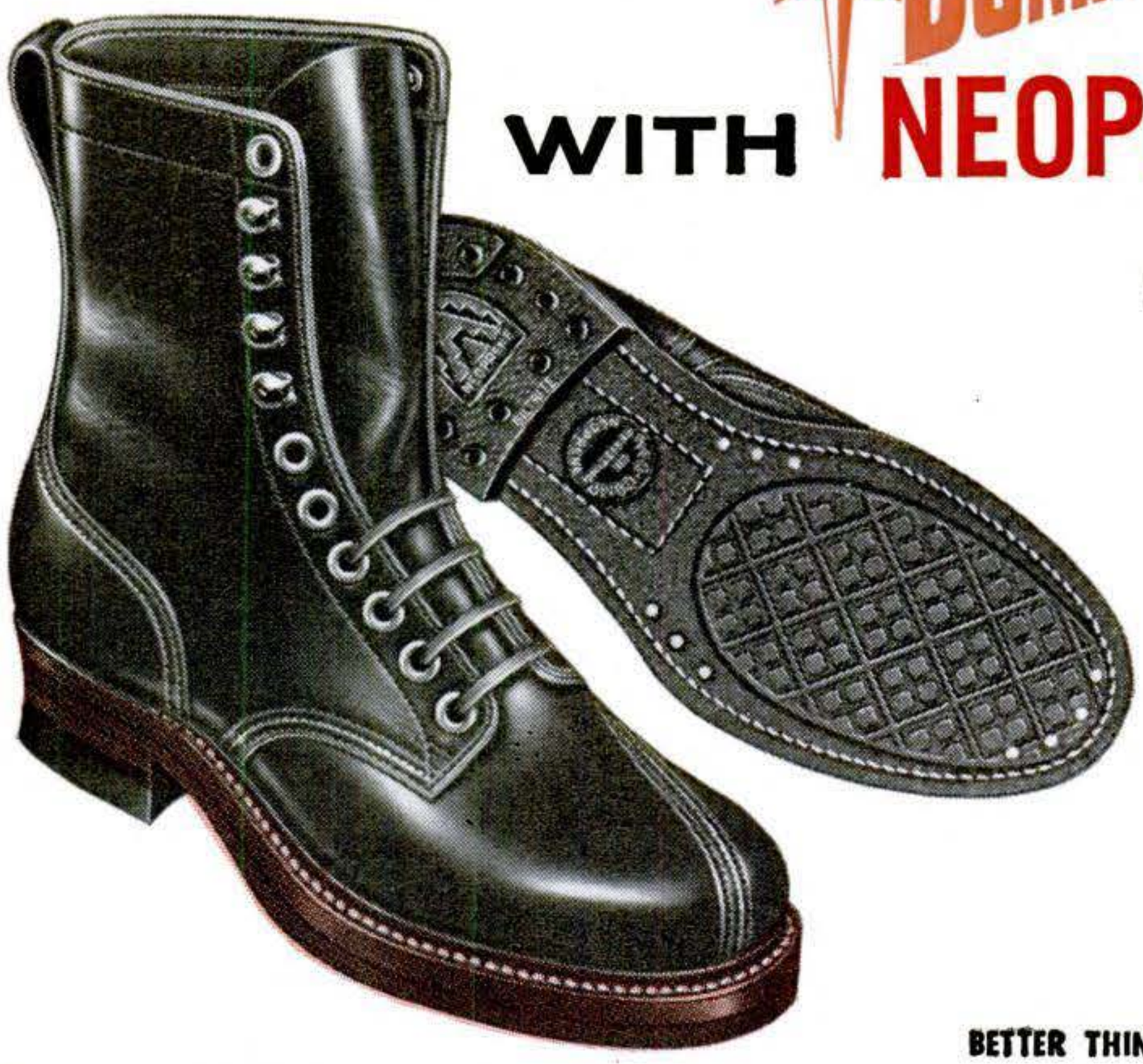

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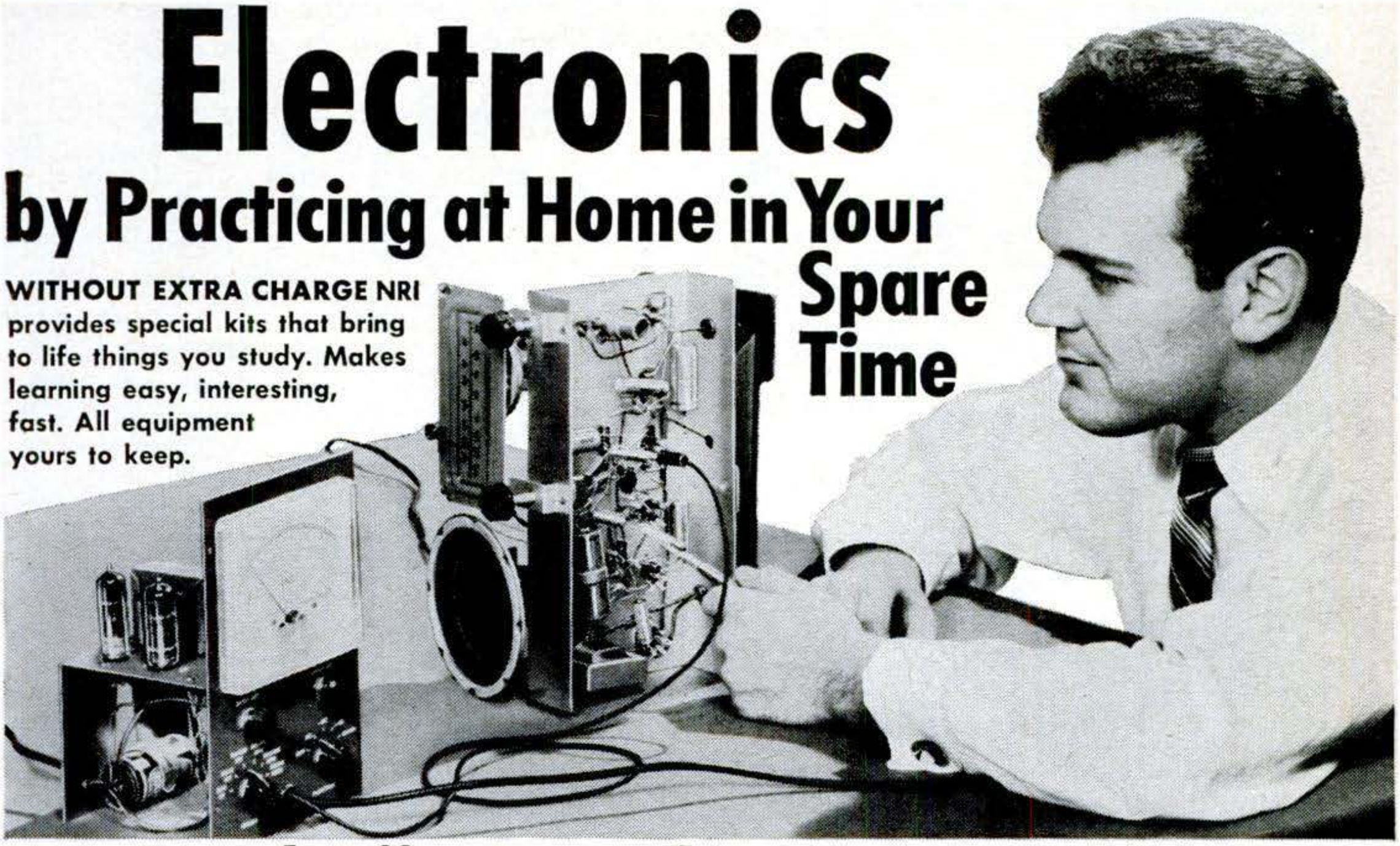

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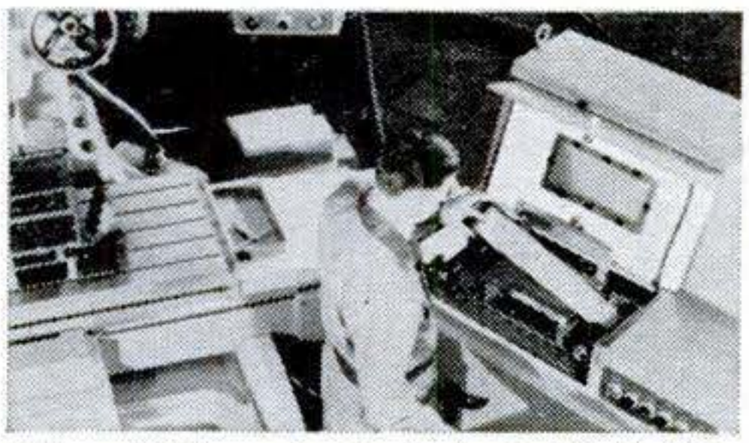

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J. M. SMITH
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After graduating I was a shipboard radio operator. Now I am chief engineer at Station WARA.

NRI was a wonderful foundation. RAYMOND D. ARNOLD, Attleboro, Mass.

Thanks to NRI I am in a top position with the Federal Aviation Agency in the Navaids Electronic Section. JOE DUCKWORTH, Fort Worth, Texas.

Four months after starting your course I left my job in a hardware store to work at Raytheon Manufacturing. Now I am an engineering assistant in Microwave Power Tube Research and Development Laboratory. LEONARD BLOOM, Newton Centre, Mass.

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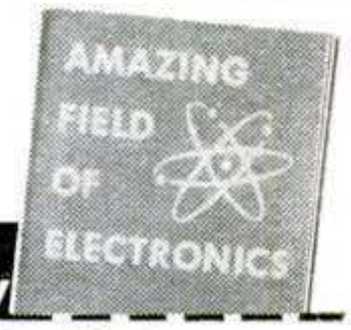

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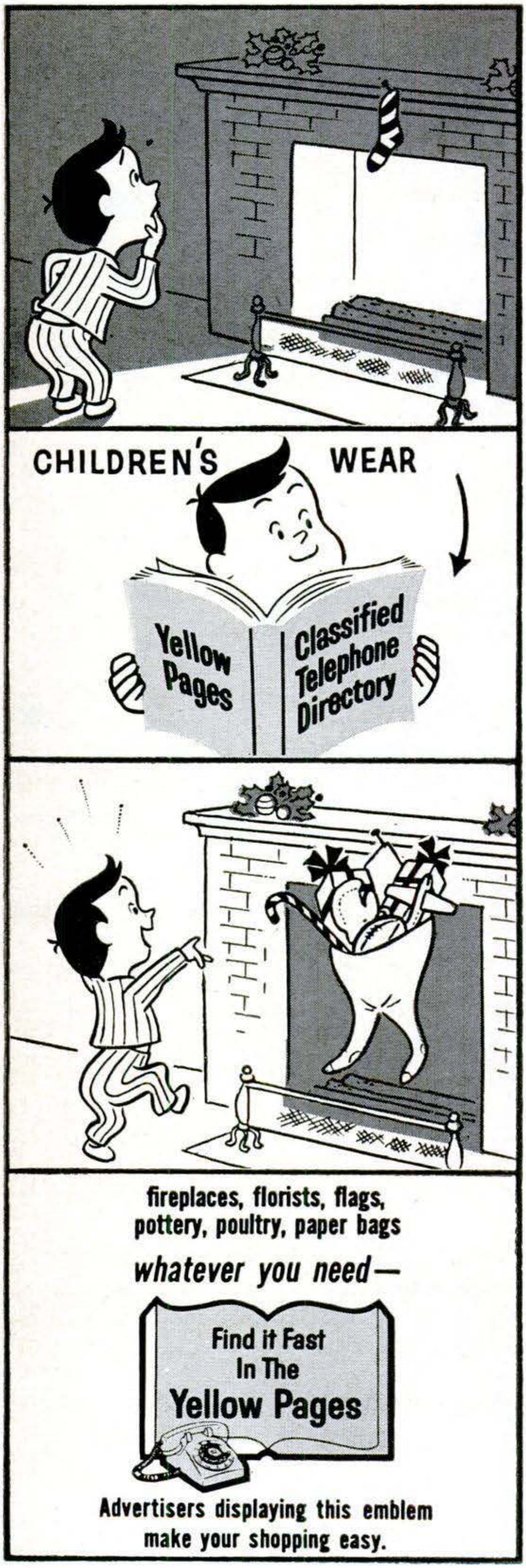
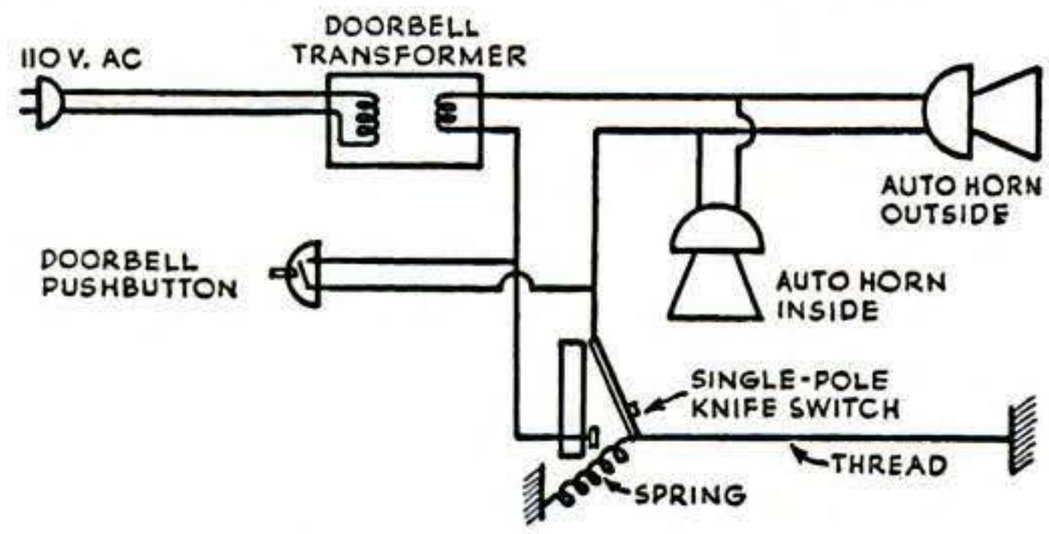


In the daytime, place a rubber tube over the contact poles and release the thread. One or several traps can be made in the house from the one circuit, and you can install more horns if you wish. But in the dead of night two horns make enough noise to start any burglar sprinting for the next county.

RALPH FISHER, Crooksville, Ohio.

An exposed knife switch or a doorbell pushbutton should not be used in a 110-volt circuit. You could be electrocuted



that way. Move the switches over to the secondary side of the transformer; then they will be safe. The amount of current used by the transformer is insignificant.

Still Pushing Up Pisa

TO SAVE one of the world's great monuments ["The Leaning Tower Is Falling Down," Sept.], any idea is worth considering.

Why not install refrigeration and water-injection pipes deep within the earth on the depressed side of the building?

With repeated water injections followed by freezing, the building could be elevated by the expansion of the frozen water, or at least stabilization of the ground could be obtained.

Once the job was done, the cost of keeping the earth frozen would be small. The freezing process has been used in the construction of great dams.

OSCAR F. NOEL, Nashville, Tenn.

The Embarrassing Paint Bath

LET us hope that Paul Fryar, after his paint bath ["My Most Embarrassing Shop Moment," Sept., p. 122], equipped his drill press with a foot switch.

Where a motor is controlled by a simple ON-OFF switch—knife, snap, toggle, or button—the floor switch can be any heavy-duty, spring-loaded, normally open type, connected in parallel with the existing one. I've made several from old-

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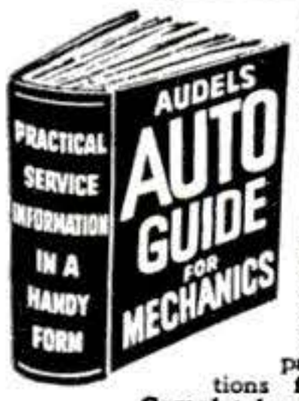

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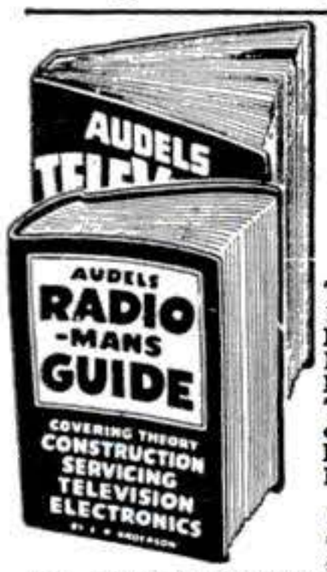

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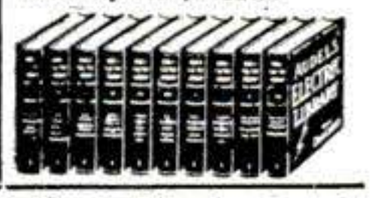

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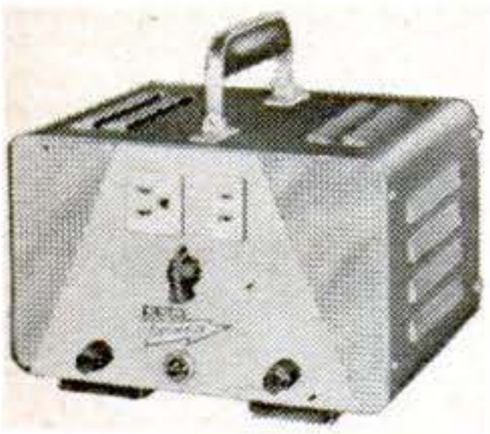

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MODEL IC-252 ACTIVERTER—Inverter-Charger operates from direct connection to 12 Volt battery. Output ratings: Intermittent Use — 250 Watts, 2.3 Amps. AC . . . Continuous Use — 200 Watts, 1.8 Amps. AC. Shipping Weight: 15 lbs.

MODEL IC-202P PAK-O-POWER—Inverter-Charger with compartment for 12 Volt battery. Completely self-contained unit. Output ratings: Intermittent Use — 250 Watts, 2.3 Amps. AC . . . Continuous Use — 200 Watts, 1.8 Amps. AC. Shipping Weight less battery: 22 lbs.

MODEL IC-506S PAK-O-POWER—The Multi-Service Inverter-Charger-Car Start unit, with large 12 Volt battery compartment and Car Start leads. Completely self-contained with built-in fast and slow charger — Charging rate: 60 Amps. for 6 Volt, and 40 Amps. for 12 Volt batteries. Output ratings: Intermittent Use — 500 Watts, 4.0 Amps. AC . . . Continuous Use — 300 Watts, 2.5 Amps. AC. Shipping Weight less battery: 55 lbs.

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One caution: A homemade switch should be well constructed and insulated, with a heavy cord in good condition —particularly if there is likely to be water on the floor.

ARTHUR F. MILES, San Diego.

Wants an Antique Engine

WHERE can I purchase an old-time heat engine or vacuum engine like the one in the article by Harry Walton ["Adventures with an Old-Time Engine," Aug.]?

FRANK GILLESPIE, San Antonio, Tex.

Antique engines like Walton's are where you find them. Nearest thing to it now is the PS Mystery Engine [Feb. 1950], which can still be bought as a kit of castings or in finished form from Floyd McGuckin, 314 N. Monroe St., Ridgewood, N.J.

Navy vs. PS

WHAT gives? Just ran across a picture of a 70-m.p.h. hydrofoil boat being tested by the U.S. Navy at The Hague, Holland. It looks very much like the hydrofoil boat built by PS editor Herbert Pfister, that I saw in the June '60 issue.

HUBERT JOHNSON, Nelsonville, N.Y.

Here are the two photos: Navy experimental craft at top, PS skimmer below

it. We can't claim 70 m.p.h.; but to the U.S. Navy, a hearty "Welcome Aboard!"

Right System, Wrong Plane

WE LIKED the Picture News story "Baggage Floats off Jet" [Oct.], describing the Glide-Aire units jointly devel-

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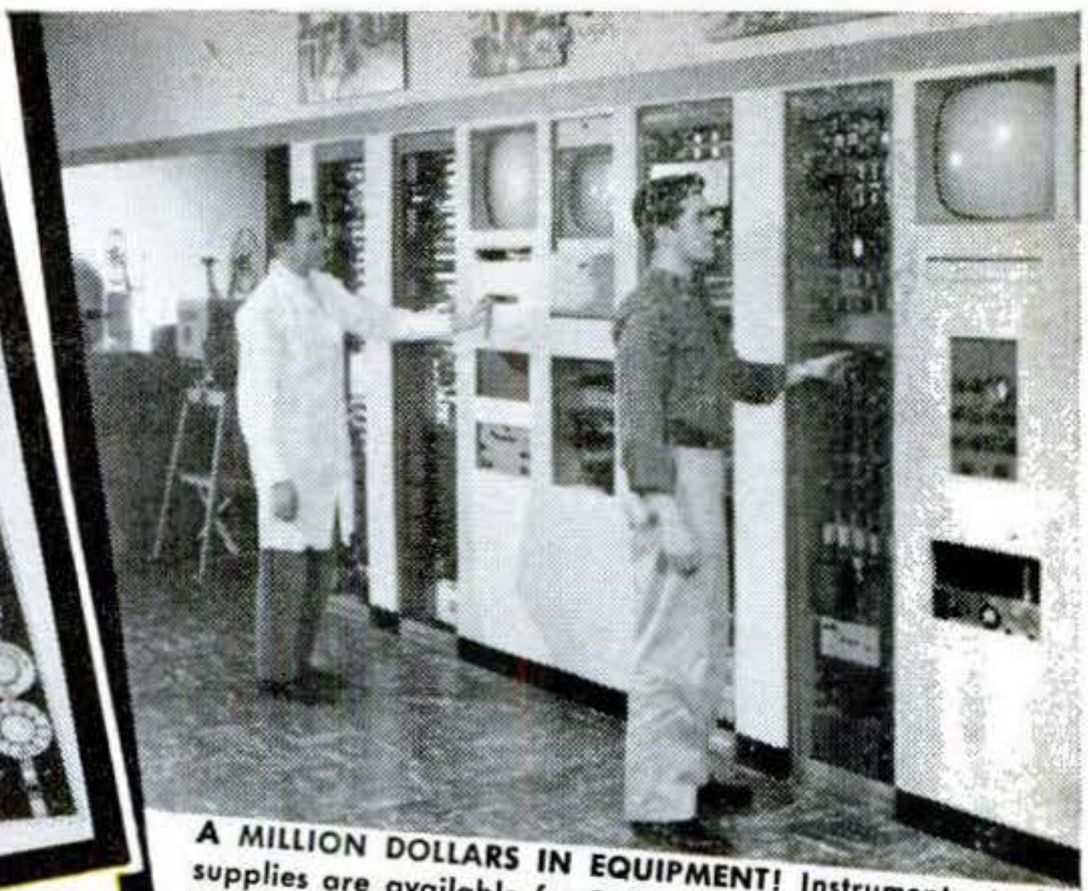

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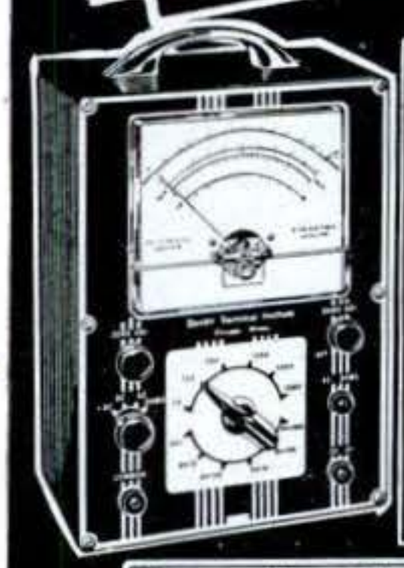

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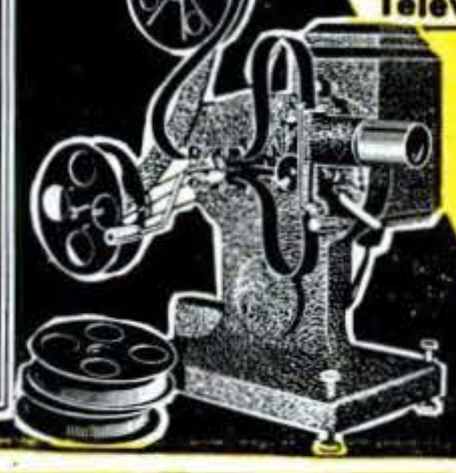

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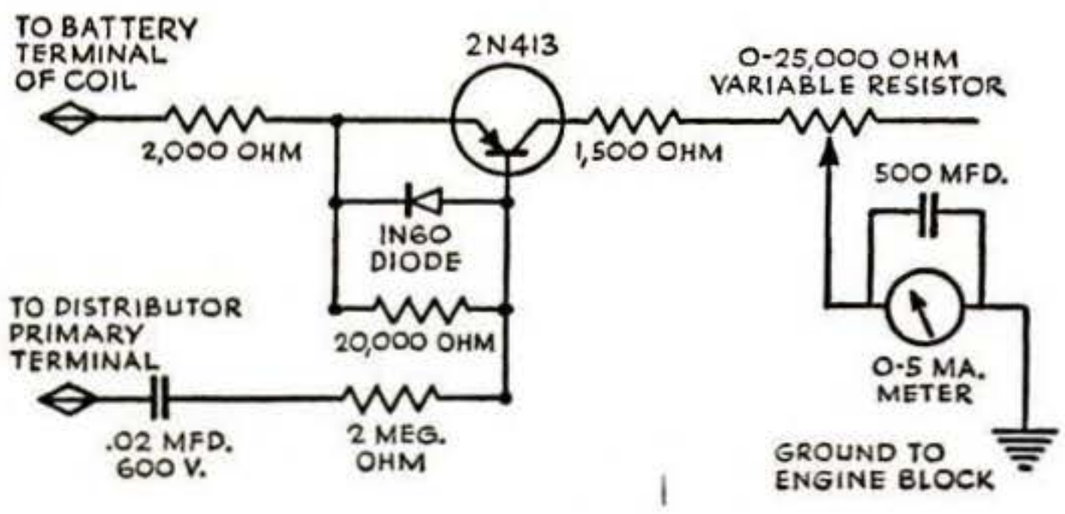
oped by TWA and Douglas Aircraft. Just for the record, I'd like to note that the aircraft is identified as a DC-8, which TWA does not operate. The jet shown is a Boeing 707.

JOHN J. CORRIS, TWA, NYC.

Dwell Meter Gets a Tachometer

LAST spring, "How to Make a Transistor Dwell Meter" [May] prodded me into activity. When I calibrated the fully assembled instrument with the aid of a professional dwell meter, it performed equally as well as the expensive unit.



A tachometer was combined with the professional unit, and I decided to modify the dwell-meter plans and devise a circuit for a tachometer, too. It works fine.

R. G. RALSTON, Omaha.

Those Mysterious Radio Signals

WHILE connecting a coil of wire to the input of my tape recorder, one of the leads to the coil touched the radiator and was grounded. Immediately, I heard several radio stations simultaneously through the speaker. I turned on a radio and changed stations until I heard the same music as that coming from the recorder. The loudest station was at about 900 kilocyles. It occurred at about 11:30 at night. Can someone solve this mystery for me?

MARK ELKINS, Brooklyn, N.Y.

Radio programs received on heating pipes, plumbing, and even the bridgework of a person's teeth have been reported. The explanation: A junction between two pieces of metal is acting as a semiconductor—detecting the radio signal just as a crystal radio does.

Forging in a Bucket

LAST summer, I clipped the Don Engdahl piece ["I Forge Metals in a Bucket," June] and have successfully melted lead

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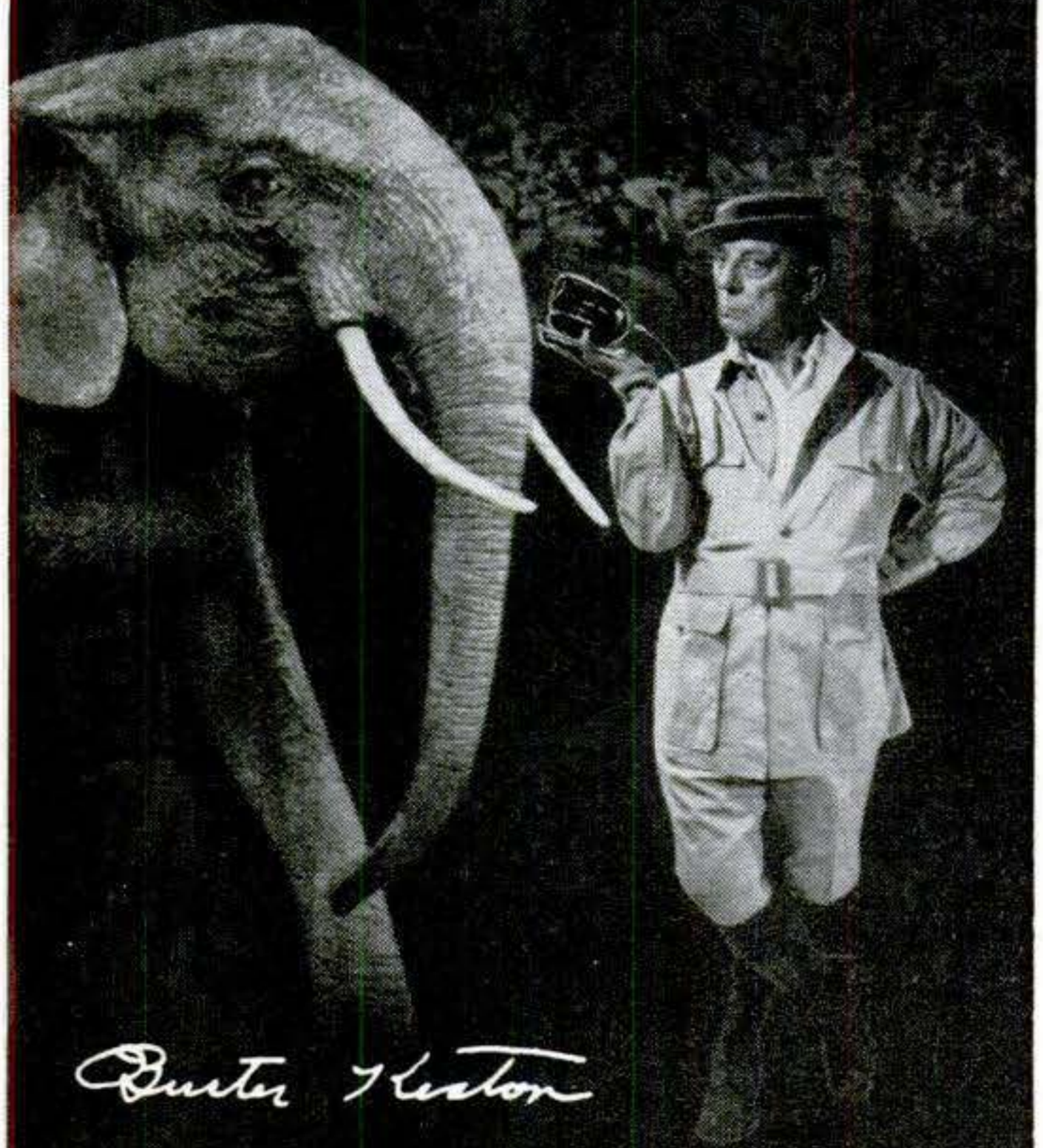
"I brush his teeth with my Wen Sander-Polisher"



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following his directions. I have made numerous attempts to melt aluminum. I used charcoal, soft coal, even hard coal, packing the earth cone around the fire, but with no luck. Could a too-large ladle be the trouble?

J. A. BITTMANN, New Brunswick, N.J.

A smaller ladle would help. Also enclosing the bucket in a brick housing to hold in the heat.

More Uses for Old Socks

IF THAT man who wants some uses for old socks [Oct.] has tender feet, here's a tip for him: Slip a pair over new shoes to test them at home. Then if you want to return them later, the soles will still look like new.

JAY ASHLEY, Newark, N.J.

. . . MAKE work mitts to protect hands against dirt, abrasion, or allergy. Add a thumb if desired.

MRS. R. ROUNING, Nogales, Ariz.

. . . USE them to slip-cover your shoes when you pack a suitcase.

MRS. E. BLATTBERG, Brooklyn, N. Y.

. . . KEEP 'em in your workshop. They're wonderful for dusting wood after sanding, wiping up spills, cleaning off anything and everything. You name it—if it is applied, wiped off, or buffed with a rag, an old sock is the thing for it.

MRS. LEWIS M. WAGGONER, Granite City, Ill.

That Arcane Arc

IN YOUR problem about the LP record ["PS Puzzlers," Sept.], you omitted some important information—the length of the

arm to which the needle is fixed. Since the arm pivots on one end, the needle moves in an arc and its travel is something over 3¼ inches. The radius of the

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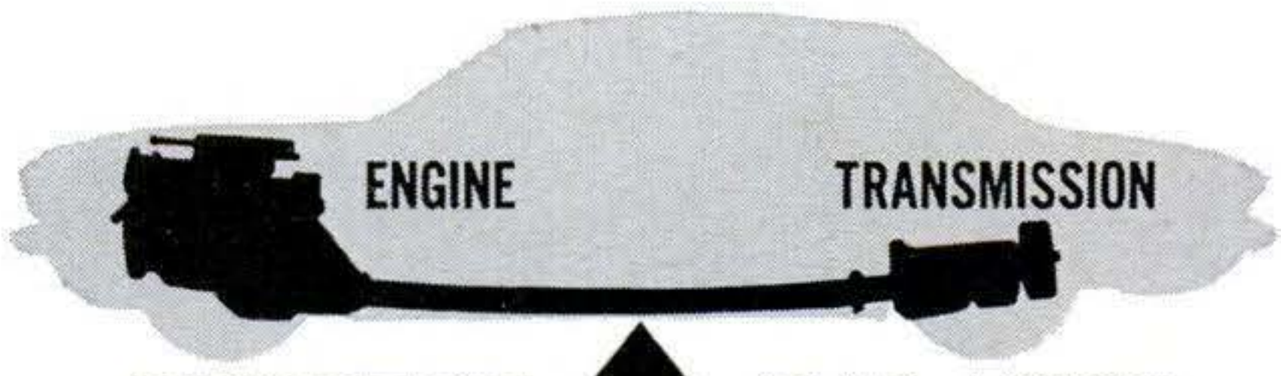

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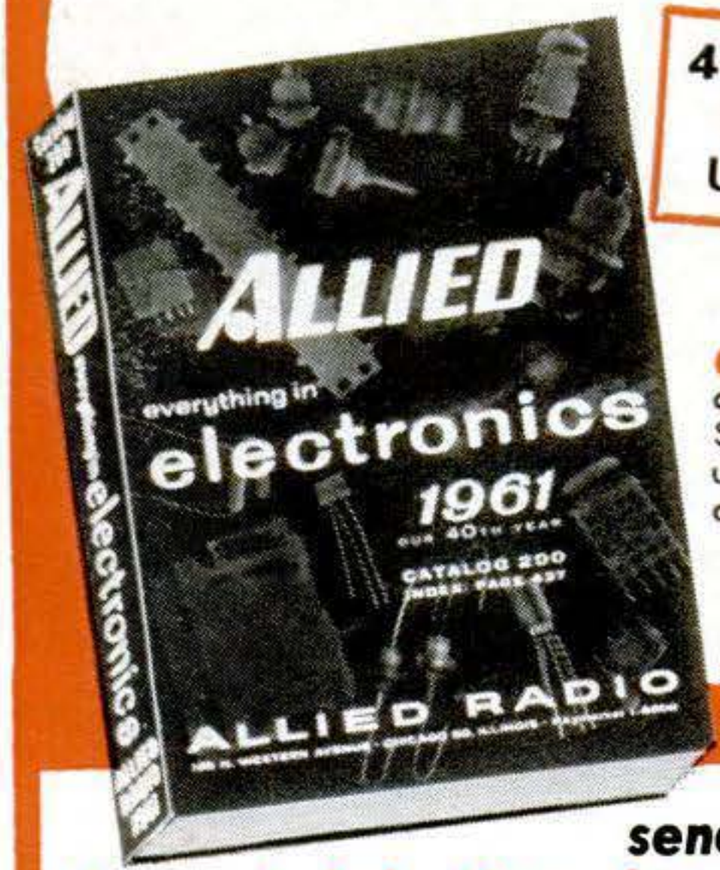

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arc must be known to arrive at the exact figure.

D. A. JOHNSON, Hibbing, Minn.

. . . YOUR turntable must either be equipped with a special radial tone arm or an infinitely long arm. Otherwise the stylus would travel in an arc, whose length is given by the formula:

$$s = (R)\left(\frac{2 \text{ arc } \sin \frac{3.25}{2R}}{}\right)\left(\frac{\pi}{180}\right)$$

where R equals the distance from the pivot to the stylus in the tone arm and the arc sin is in degrees.

WILLIAM STERLING, Pittsburgh.

. . . THE true distance traveled by the stylus (where x equals the length of the phonograph arm, and angle 1 equals that angle produced by the arm when in the starting and ending positions) would be:

$$\frac{(3.1416)\ (2x)\ (1)}{360} = \text{distance}$$

ROBERT FREY, Niles, Ill.

. . . SINCE neither the arm length nor the position of the pivot point were stated, the puzzle is truly a puzzle. But if we assume the pivot point is on a line tangent to the middle groove of the record, an arm 7 inches long would make the distance traveled 3.27 inches; very close to the 3¼ inches erroneously arrived at.

R. C. JOHNSTON, Pomona, Calif.

Souping Up a Car

HERE'S a trick I learned from my Dad years ago for sealing a cracked block inside or outside, or for sealing rusted freeze-out plugs:

Peel two large white potatoes, cut them into small pieces, and boil down

into a thin soup. Run the engine until warm, then pour the soup into the radiator and run the engine about 15 minutes. As the spuds come through the cracks and hit the air, they harden like

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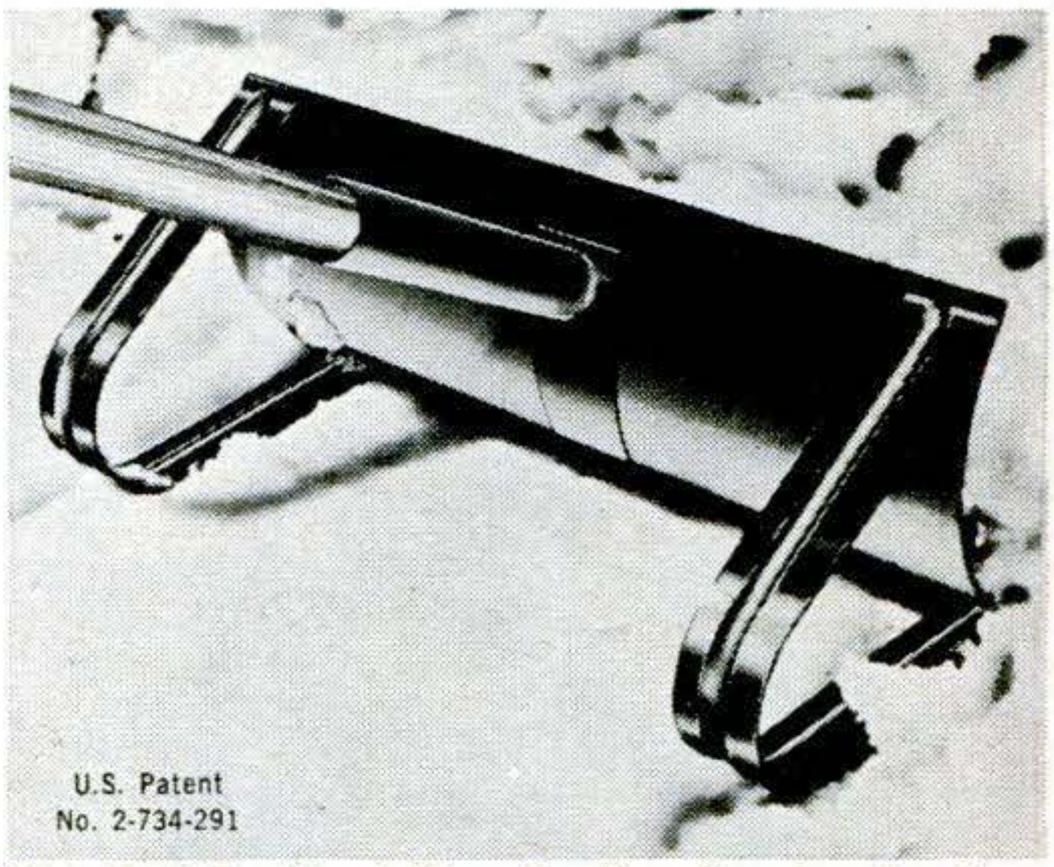
- ★ **Clears Away Slippery Snow Before It Causes Bodily Injuries Or Costly Lawsuits**

From Kansas City, Missouri comes news of an amazing lightweight easy-to-use device that saves the strain of continuous snow shoveling . . . clears snow quickly from almost any surface — even uphill — conserves your strength . . . rids your property of slippery snow that could result in injuries to you or your loved ones, and costly lawsuits by strangers — and does all this in most cases in minutes!



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A Bulldozer Driver's Invention

The secret is a patented "gliding angle" Sno-Dozer that slides on sleighlike runners. It was developed by Charles Lasker, bulldozer driver from Kansas City, who observed how quickly and easily bulldozers move giant mounds of heavy snow, dirt, gravel and other bulky material.

Mr. Lasker reasoned that if he could apply the sliding scoop principal used by bulldozers to a lightweight hand-operated clearing device which glided easily on runners like a sled, it would be so simple and easy to use that even a child could clear snow faster than ever before, and with less effort.

Mr. Lasker finally created a device that met his strict performance requirements. He named it Sno-Dozer, patented it, and marketed it on a small scale. Already more than 50,000 Sno-Dozers have been sold throughout the country

From all over come reports of the speed, the ease, the simplicity with which Sno-Dozer removes snow from any area . . how it glides along like a sled on its patented runners — no wheels to stick in snow, jam, or fall off — no continuous backbreaking lifting as with shovels — No "digging in" or "catching" as happens when you push a regular snow scooper or shovel.

These letters prove that with Sno-Dozer, snow-clearing need no longer be a backbreaking chore. Women and older folk in particular appreciate the ease with which Sno-Dozer glides along pushing snow out of the way. For example, Mary Schandera, Storrington, Conn. writes "My driveway is all up-hill and quite long, so to go back and forth across it (with a shovel) would have been an almost endless task. (With Sno-Dozer) In a few minutes I had made myself a lovely path down to the road" . . .

. . 84-year old Leon L. Botte, Maumec, Ohio calls Sno-Dozer "a blessing in disguise for us in the 'antique' class" . . . while Mrs. Joseph Cychol, Auburn, Maine writes "We had one of the worst winters I've experienced for years. To say we were glad we had a Sno-Dozer was putting it mildly."

Do you know what this means to you? It means that you can clear snow with much less strain on your heart, your back, your legs than shoveling . . that you no longer have to spend all your winter spare time clearing snow and resting because you're so tired from the shoveling you've done. It means that if you earn spare cash shoveling snow for other people you can boost this income by clearing the same amount of snow in far less time than shoveling takes.

Don't Waste Time and Energy Like This . . .

. . . When Sno-Dozer Glides Away Snow Like This!

Why Sno-Dozer Works Like No Shovel Can

The angle of the scoop to the ground is the precise angle of a bulldozer blade on a tractor, so that snow does not stick to the blade, but rolls in front of it. And Sno-Dozer's sleigh-like runners just glide along quickly and easily over gravel, cracks, grass without catching.

You'll find that Sno-Dozer not only gives you outstanding performance, but is made of the finest materials to give you years of service. It's 18-gauge curved steel blade is hot-rolled and pickled in oil to give rigidity, resist bending, nicking, and rusting . . . the 16-gauge steel runners and ferrule are spot-welded by a special process for a lifetime of use . . . and the rugged, lightweight no-stoop handle is exactly 1⅛" in diameter for easy grip, and 54" long for easy use.

Make Extra Money Clearing Snow

Why stoop, bend, and strain so much to shovel snow for spare-time cash when Sno-Dozer so often does the job easier and in far less time, making it possible for you to boost your income by doing more jobs faster and with less strain.

AMAZING TRIAL OFFER

Stop being a slave to winter snows. Avoid the bending, stooping, backbreaking job of continuous shoveling, when Sno-Dozer glides along over grass, bricks, boards, slate, etc., pushing snow away without "digging in" or "catching." See for yourself how fast and easily Sno-Dozer glides along without the usual stress or strain of constant shoveling. Use Sno-Dozer on your sidewalk, in your driveway, on your roof, porch, steps — even uphill — and prove to yourself how it can clear snow faster and easier than you ever thought possible.

Put Sno-Dozer to every test. See for yourself that Sno-Dozer can do for you in your snow area everything we say. Sno-Dozer must work for you! You must be delighted . . . you must be convinced that Sno-Dozer is the finest snow-clearing device per dollar spent that you ever used . . . it must be suited to your area, or it won't cost you a penny.

Sno-Dozer In Limited Supply

All that amazing patented Sno-Dozer costs is $3.98. Only if you act at once can we guarantee to fill your order promptly. This NO-RISK offer may not be repeated in this publication again this year. To get your Sno-Dozer before the big snows, rush your order at once on the amazing trial coupon.

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steel. Drain off the watery mix and refill the radiator with fresh water.

C. E. RICHARDSON, Great Bridge, Va.

Ground corn was used in a similar fashion back in the Model T days. One big drawback (whatever the soup): It often clogged the radiator as well as the leaks. At best it's a temporary fix and one you'd want to use only on an old junker. We doubt that it would hold on a modern pressurized radiator.

Beautifying America

MAY we reprint "Fancy Ways to Hide Trash Cans" from the Home Improvement Ideas section of your September issue? We'd like to distribute it to community leaders active in litter-prevention and community-beautification programs.

BEATRICE COE

Keep America Beautiful, Inc., NYC.

Paging Izaak Walton

THE anglers on your staff must have been asleep. Tell Peggy Kaluz ["I'd Like to See Them Make," Sept.] that the Ashaway Line & Twine Co., Ashaway, R. I., has been making self-measuring lines since 1934. They're good, too.

RALPH B. LAWRENCE, Reading, Mass.

. . . SEVERAL line manufacturers make a braided nylon line, both standard and with a lead core for deep trolling, with a color change every 10 yards. The lines come in various test strengths, and may be had in 100-yard or longer lengths.

JACK BYERS, Norwich, Conn.

Buy a Wind Tunnel?

I ALMOST dashed out to buy a bike when I read T. U. Angell's nostalgic letter [Oct.]. Then I remembered how exhausting pedaling around here is.

Now I'm all het again. Just heard that

"So much fun to assemble..."

"She smooths out the roughest terrain..."

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YOU BUILD IT...START IT...STOP IT...

ITC BATTLING BETSY TANK KIT

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Peking Radio says the strain of riding a bike against the wind has been solved. Some Chinese has devised a wind-driven canvas fan you attach to the handlebars. This is linked to a gear on the axle. The harder the wind blows, the faster the bicycle runs. Now all I need is some direction on how to get the wind blowing in the right direction.

J. T. OLESON, San Francisco.

Mr. Schultz Identified

KEN FERMOYLE'S article on "Henry Ford's Weird Old Engines," [Aug.] was especially interesting to us. The unnamed engineer shown in the picture

with Mr. Ford happens to have a name —Karl F. Schultz. We have the same picture among our souvenirs.

I was very disappointed that his name wasn't mentioned. He is my husband.

MRS. KARL F. SCHULTZ, Savannah, Ga.

The Answer: $ $ $

IN YOUR October letters column, the Hudson was extolled as the only car to have, as a safety feature, auxiliary mechanical brakes. If your master cylinder failed, you went down on the mechanical brake. Why don't present American cars use this feature?

MARK BUFFAMOYER, Lebanon, Pa.

The answer: money. If manufacturers thought every customer would pay five dollars more for an auxiliary mechanical braking system, they would install it.

. . . I ONCE lost the brake fluid on my '49 Hudson and didn't bother with repairs for 30 days. The mechanical brakes held fine.

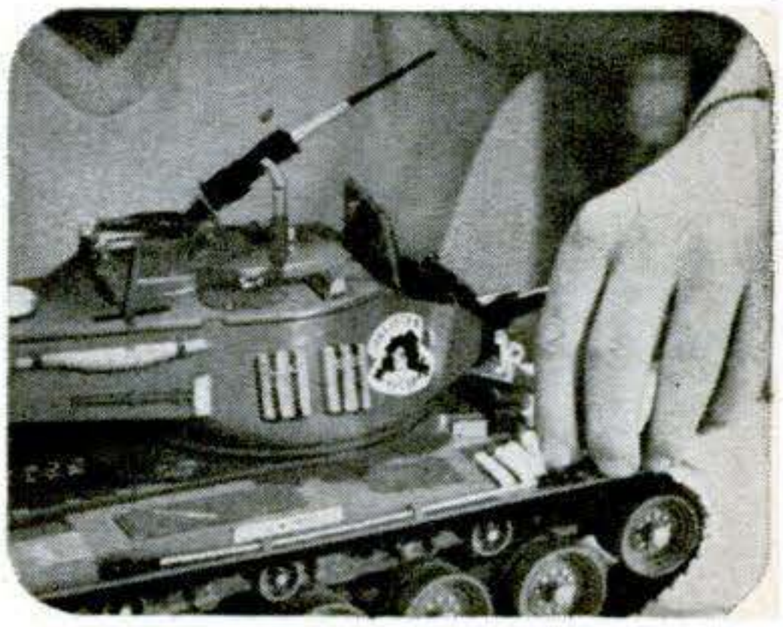
ROBERT PALMER, Hickman Mills, Mo.

. . . WHY did they stop making the

CONTINUED

"...fires shell after shell...automatically"

"Her turret rotates from side to side..."



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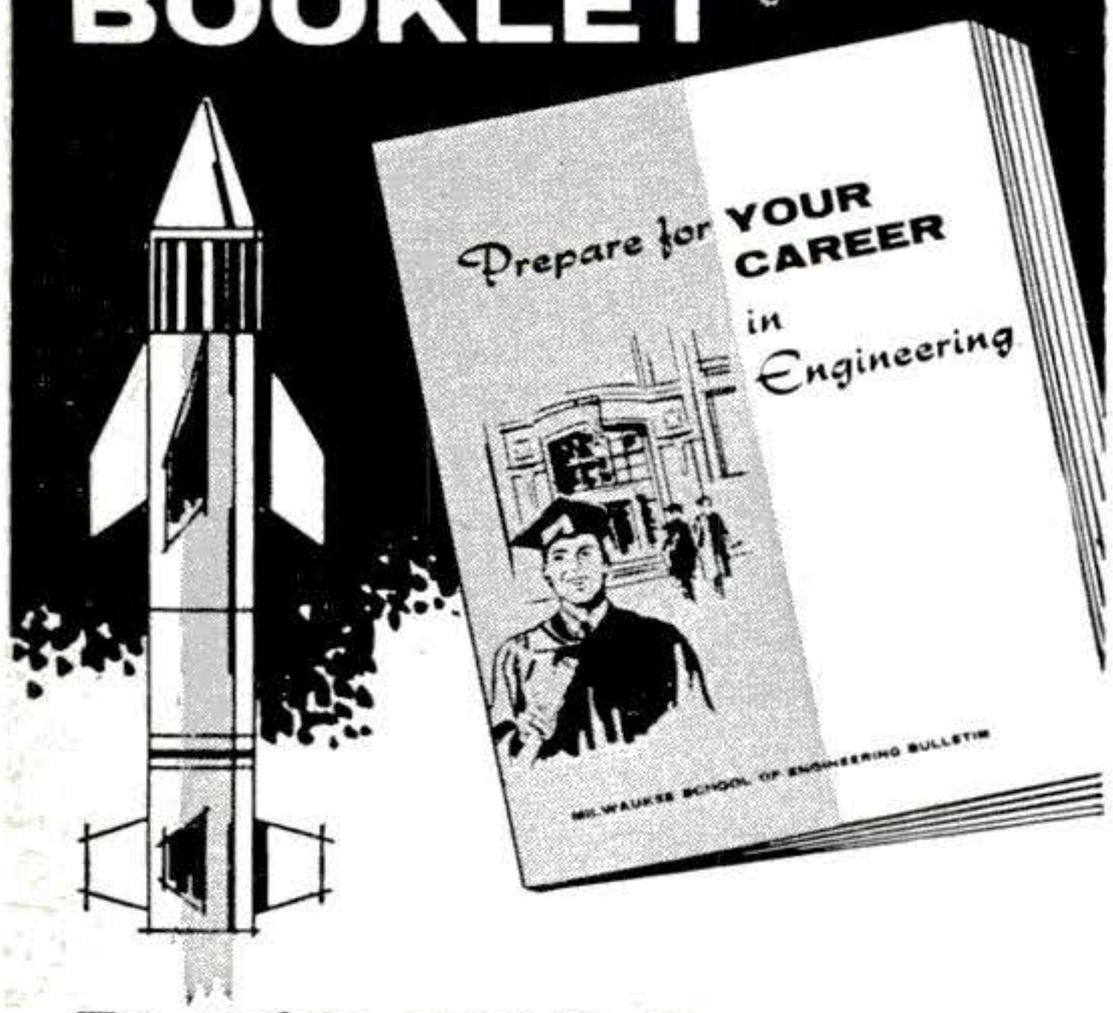

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B. J. ALLARD, Minneapolis.

Radical Compact Not So Radical

I DISAGREE with your statement that the Pontiac Tempest ["Radical New Compact," Sept.] is the first U.S. car to use a transaxle with the engine up front. The Briscoe Motor Car Co. of Jackson, Mich., had such a car in their Model 24, built in 1919.

CLAUDE C. FLICK, Jackson, Mich.

. . . THE Overland Country Club (circa 1916) had a front engine and rear transmission.

E. L. BARROWS, Long Beach, Calif.

Correct. The 1919 Briscoe and 1916 Overland did, indeed, have transaxles with the engines up front. Moreover, Overland offered transaxles in 1913 and 1914.

A Word to the Wise

THE use of a rotary lawn mower for clearing leaves off a sidewalk ["Short Cuts and Tips," Oct. p. 179] seems to me to be hazardous. Raising the mower for any reason while the blade is operating can mean crippling injury to anyone nearby. It is also very dangerous if there are any animals in the vicinity —especially cats, which are very quick moving.

VERN OSBORN, Sacramento.

Taking Kinks Out of Wire

YOUR tip for straightening wire by holding one end in a vise and chucking the other in a hand drill [Aug., p. 119] sounds good, but I have a faster and much easier way. Hold one end in a vise, grab the other end with pliers, and give the wire a quick jerk. Pronto, it's straight.

WM. HORRELL, Louisville, Ky.

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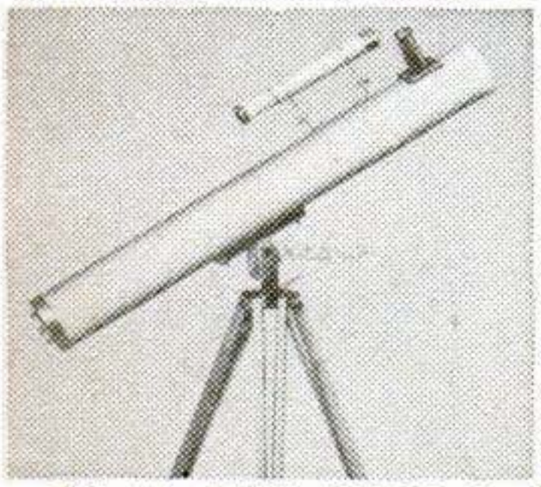

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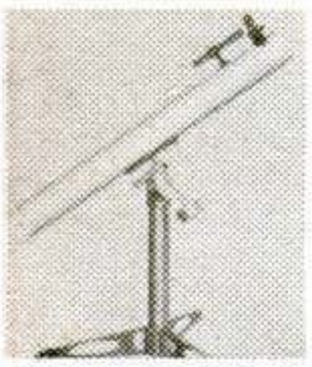

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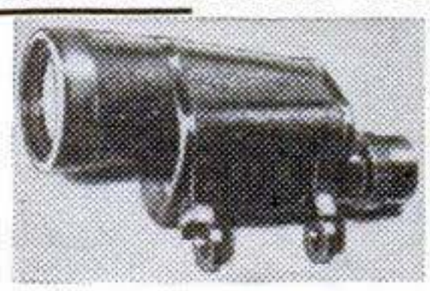

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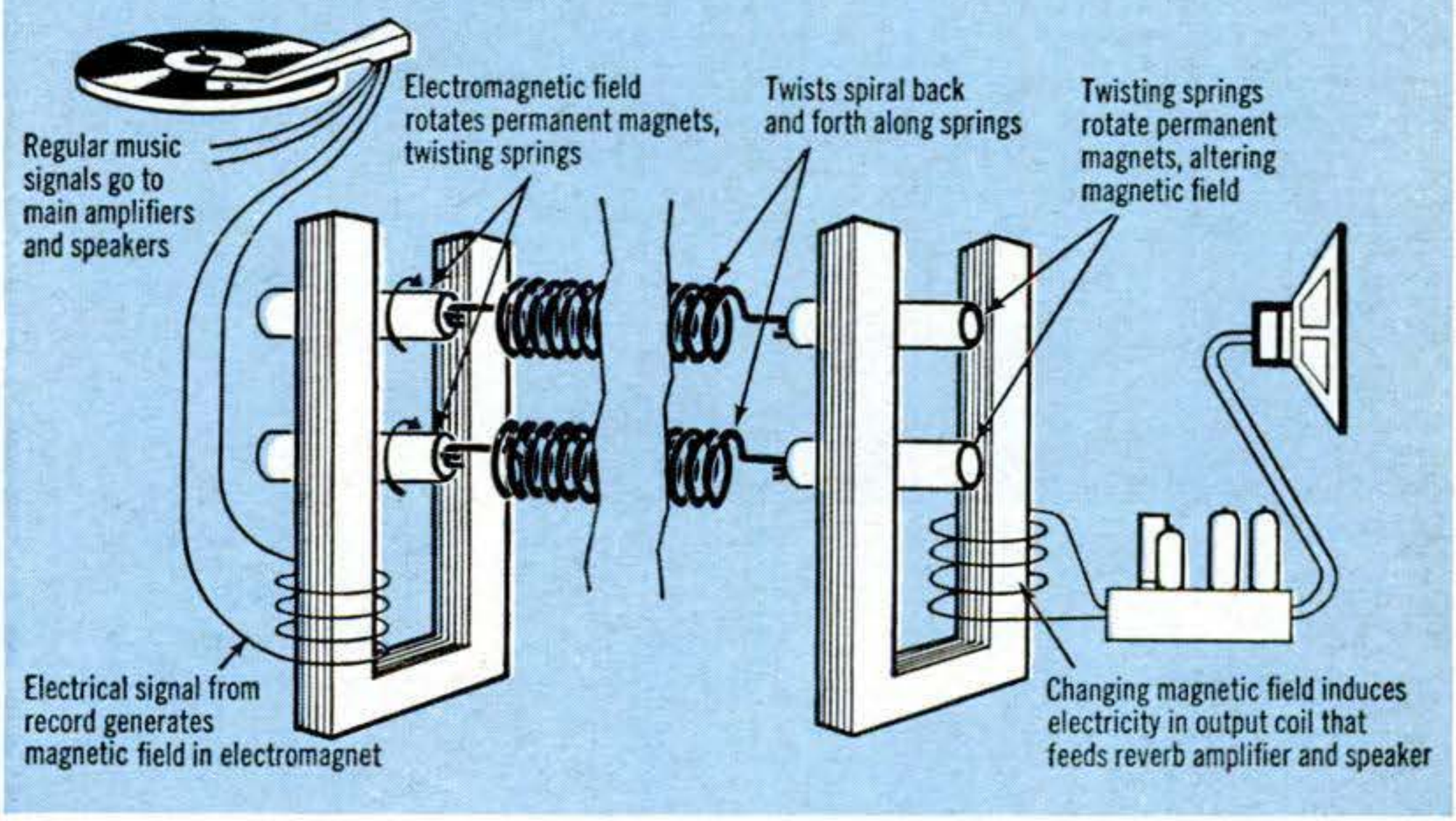
By Martin Mann

The month in science

Echo in the hi-fi. Audio engineers, not satisfied with hoking up pop records so that the vocalists sound as if they were singing inside Mammoth Cave, are now putting echo chambers right into the phonographs. The classier stereo consoles this year all have "reverb" (short for reverberation). The effect on recorded symphonies may be questionable, but the gadget itself is ingenious. It's just two springs and some magnets.

How springs and magnets make living room sound like concert hall



The idea is to make records played in your living room sound more like a live performance in a concert hall. The live performance gets much of its brilliance from the auditorium itself. There you hear not only music direct from the orchestra, but the same sounds reflected to you a split second later by walls and ceiling. No living room is big enough to provide this vital reverberation. But it can be added artificially by the phonograph.

All hi-fi makers use the same reverb unit, developed by Hammond Organ. It is a long, skinny metal box containing a pair of coil springs connecting two transducers. The input transducer converts the music signal into a twisting motion, which travels down the springs to the output transducer. There the twisting motion is converted back into an electrical signal. Each twist is reflected back and forth along the spring several times, weaker each time, so each input signal generates many progressively fainter output signals—an electromechanical equivalent of sound reverberation in a concert hall. There have to be two springs, slightly different, to make up for the fact that each has a natural vibration rate at which certain motions would cancel themselves out completely.

The reverb output signal can be added onto the original music signal and run through the set's main amplifiers and speakers, or, as in Motorola consoles, it can be fed to a separate amplifier

CONTINUED

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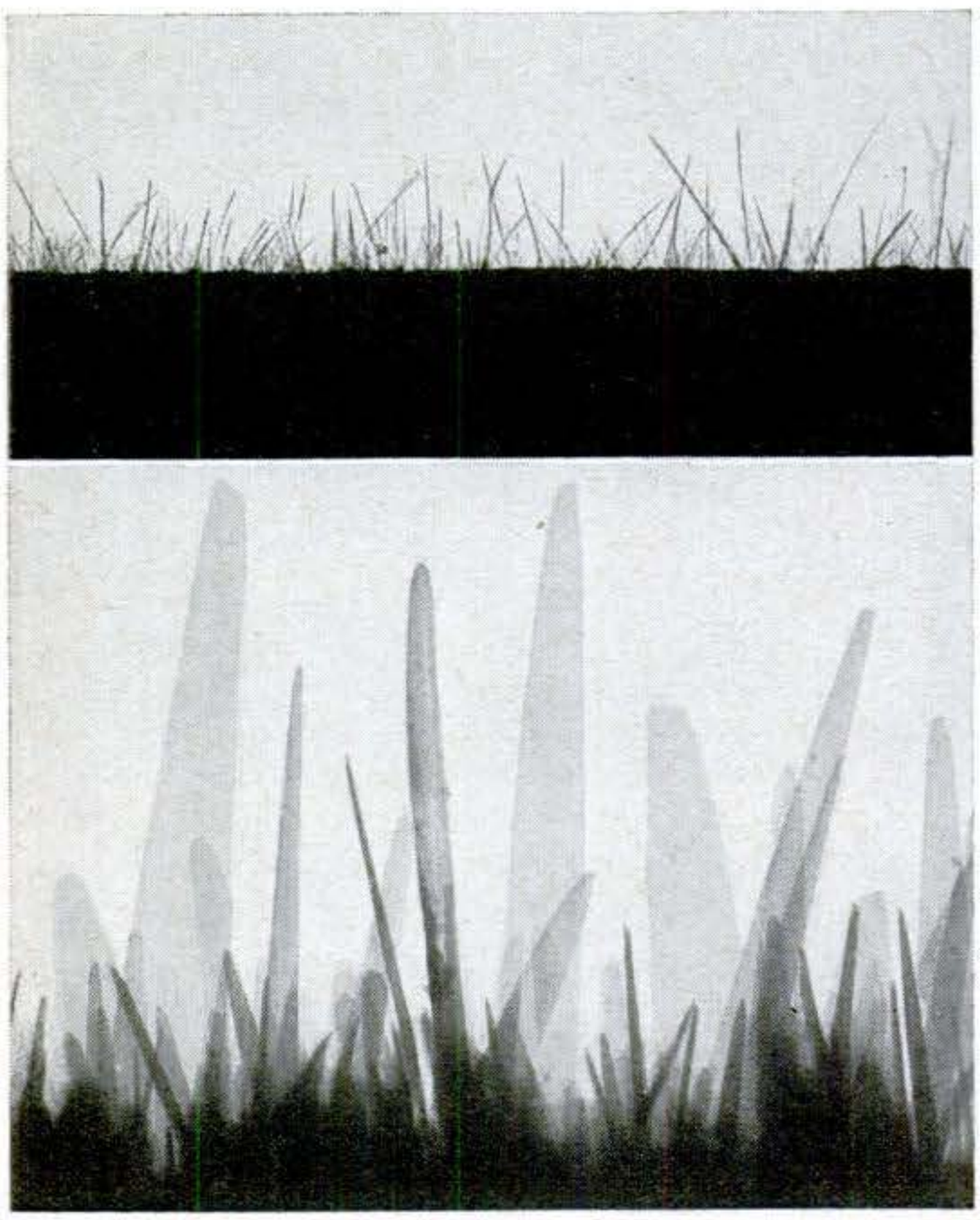
and speaker. There's also a control knob so you can cut the whole thing out if you don't like it.

What makes iron rust? Corrosion of iron costs the U.S. $7 billion every year ($80 million of that just to replace auto mufflers). But nobody is quite sure why it happens. Now a new theory from two Westinghouse researchers may lead to more rust-resistant iron and cut that fantastic loss.

Many ordinary metals (copper, aluminum) react with oxygen from the air to form oxides. But their oxides are tough, thin films that protect the metal underneath. Iron doesn't react that way. Its oxide grows until the whole piece crumbles into red dust. Everybody knows that moisture is the culprit. In dry air, iron can form a thin protective coat of rust, like copper and aluminum. A notable example is the iron Pillar of Delhi, which has stood in India's dry climate for 1,600 years barely touched by corrosion.



The difference between harmless dry rusting and destructive damp rusting is dramatically shown by these photographs, which Dr. Earl A. Gulbransen and T. P. Copan made with an electron microscope. Dry rusting (top picture) produces very tiny separate whiskers of oxide crystals, each sprouting from a single spot on the metal—like the stem of a plant. The whiskers average only .000,001 inch in diameter and .000,03 inch in height. When dampness is present (bottom picture), the oxide crystals are entirely different: blade-shaped, and 10 times bigger than the dry whiskers. More important, many blade crystals sprout from each spot on the metal.

The scientists blame the change in crystal growth on water's hydrogen atoms. The hydrogen penetrates into the iron metal, enlarging the spots from which the oxide crystals grow and spreading the reaction throughout the surface of the iron. Their cure: prepare alloys that prevent hydrogen from boring in and stop the oxide spots from growing.

Tranquilizer + Alcohol = Don't Drive. If you're one of the many people who keep calm with meprobamate pills (Miltown, Equanil), better not drink at all before driving. Indiana researchers found that even a little alcohol—much less than could get anybody into trouble with the cops' Drunkometer—made meprobamate users too tipsy to drive safely.

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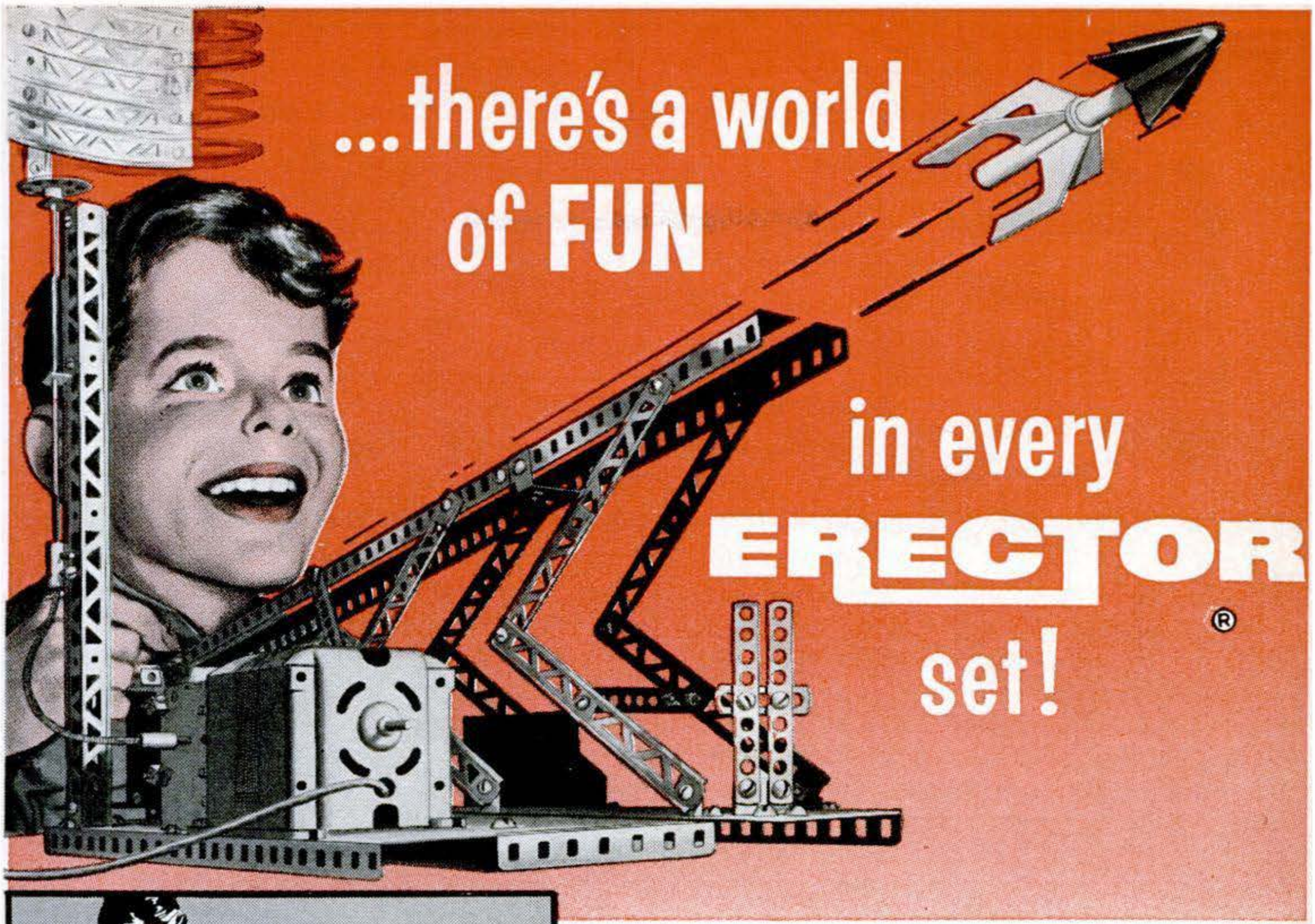

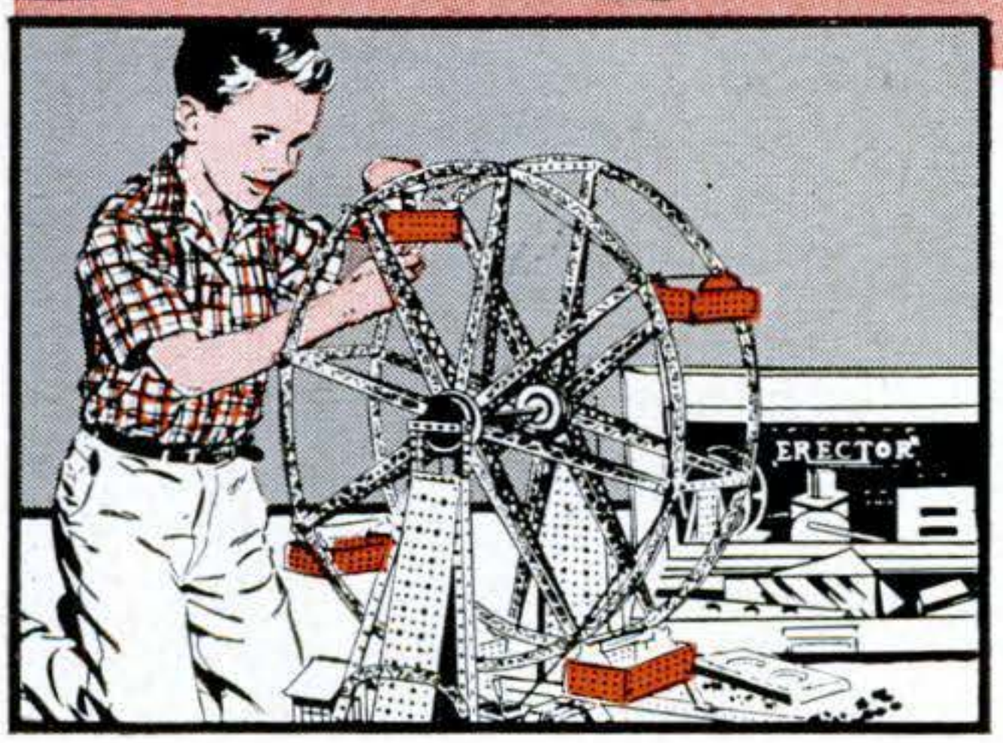

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PS Puzzlers By Joan Steen

Pernickety posers for problem solvers . . . Answers on page 229

How Would You Split Stock for Fair Shares?

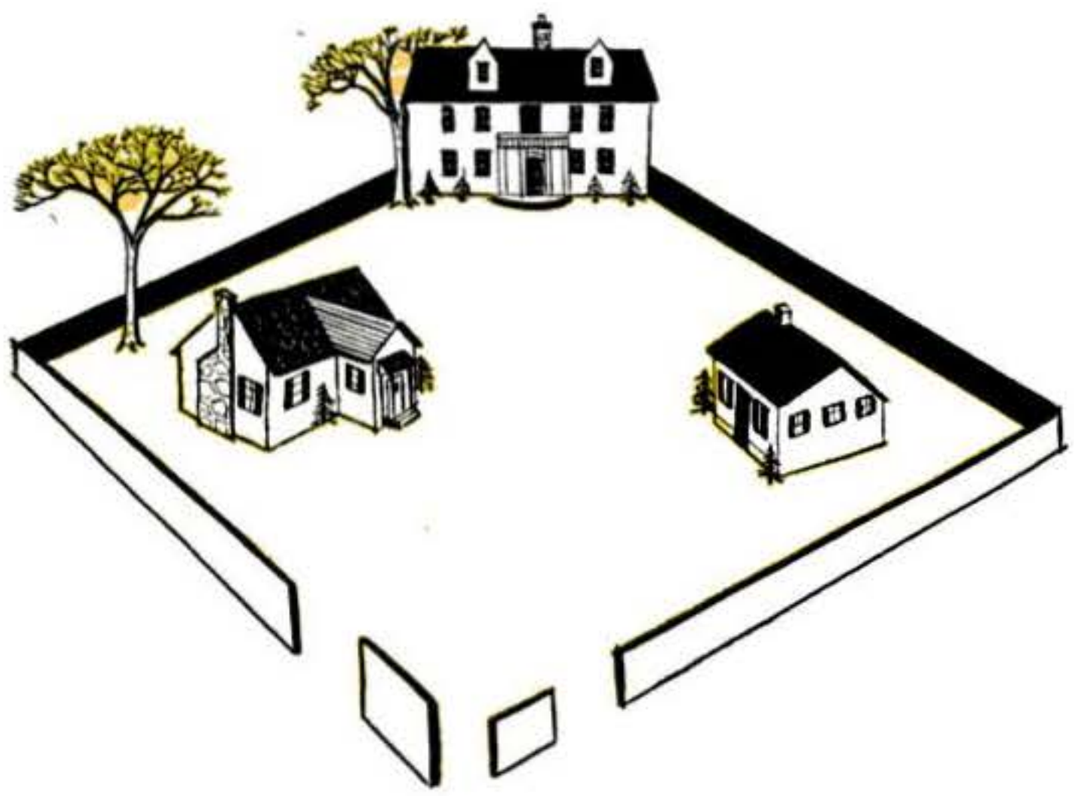
IT WAS Christmas and Grandpa decided to be particularly generous. He had 17 shares of gilt-edged securities and he thought he would split them among his three eldest grandchildren. Harry, the eldest, was to get half. Tom, second in line, was to get one-third, and the number three grandson, David, one-ninth. The younger boys complained: That way Harry was sure to claim nine shares—more than half. But Grandpa stuck by his fractions.

In their dilemma the boys turned to their father, who'd already been the recipient of Grandpa's generosity. "It's easy," he said. "I can think of a way to divide the 17 shares and satisfy all of you." Can you?

I HAVEN'T asked you to solve a murder in a long time. Here's a case where you not only have to use logic to find the killer, but also pin down five others: the victim, the witness, the policeman, the judge, and the hangman. Here are the facts.

The victim died instantly of a gunshot wound inflicted at close range. The witness did not see the crime, but swore he heard an argument that was followed by a shot. After a lengthy trial the murderer was convicted, sentenced to death, and hanged. Now the six men involved are named Forbes, Graham, Clayton, Holgate, McFee, and Warren. And you know this:

1. McFee had not known the victim or the murderer.
2. In court the judge asked Clayton to give his account of the shooting.
3. Warren was the last person to see Forbes alive.
4. The policeman testified that he picked up Graham near the place where the body was found.
5. Holgate and Warren never saw each other. Hint: Find the victim first.



IN THE annals of Puzzledom, this is known as "Early Sam Loyd"—one of the first brain-twisters originated by that famous puzzle maker.

Three neighbors shared a small park, as shown in the diagram. The owner of the large house, complaining that his neighbor's chickens annoyed him, built an enclosed pathway from his door to the gate at the bottom of the picture. Then the man on the right built a path to the gate at left; the man on the left, to the gate on the right. No paths crossed. How did they manage it?

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How to use your

...101 uses around your home

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HANDY REFERENCE. With your left hand on the facing magazine page, pull gently away with your right hand. File carefully for reference on how to do 101 jobs around your home.

THE BERNZ-O-MATIC PROPANE TORCH COMES IN ATTRACTIVE, CONVENIENT KITS PRICED AS LOW AS $6.95

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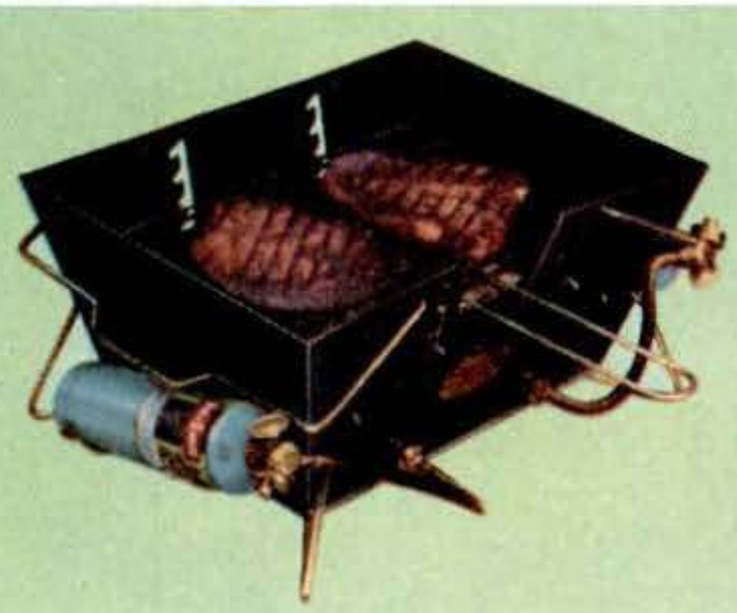
TX-888 . . . Kit includes torch with pencil burner unit and cylinder, utility burner head, flame spreader and soldering tip.

TX-10 . . . Kit contains torch with pencil flame burner unit and disposable, replaceable Bernz-O-Matic propane fuel cylinder.

"HAPPIEST WAY TO OUTDOOR LIVING"—Other fine products of the Otto Bernz Co., Inc. that run on quick, clean, safe Bernz-O-Matic Propane Gas Cylinders:



TX-1700 BERNZ-O-MATIC INDOOR-OUTDOOR CERAMIC GRILL
Cooks steaks and chops in 5-6 minutes with a "Better than charcoal" flavor — without messy charcoal—on porch, patio, kitchen or indoor fireplace all year 'round. Beautifully styled in dull black with brass finish.

TX-850 BERNZ-O-MATIC COOK STOVES
The simplest-to-operate and easiest-to-carry cook stoves made. Both double and single burner models (TX-550) when closed, make their own convenient, lightweight carrying case with all parts inside. Just open, turn a valve and light for instant heat with absolute safety. Coffee in minutes. Cooks large meals fast.

TX-750 BERNZ-O-MATIC DUAL BEAM LANTERN
The most modern, completely portable lantern on the market. Directs light both forward and down. Built-in light reflector. For convenience, safety and lighting excellence it has no equal at home or in the great outdoors.

BERNZ O MATIC

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What you should know about Bernz-O-Matic torches

THE world famous BERNZ-O-MATIC torches make big soldering jobs so simple and safe that it's easy to overlook their many other uses. If you do, you're missing a good bet. For with savvy and a few accessories, a BERNZ-O-MATIC torch can be a whole kit full of tools for hundreds of household and hobby projects.

Genie in a bottle. The savvy starts when you understand how an inexpensive but finely-made burner unit, teamed up with a fuel cylinder smaller than a quart milk bottle, can give you up to 15 hours of blue-hot flame that's as easy to work with as a paint roller.

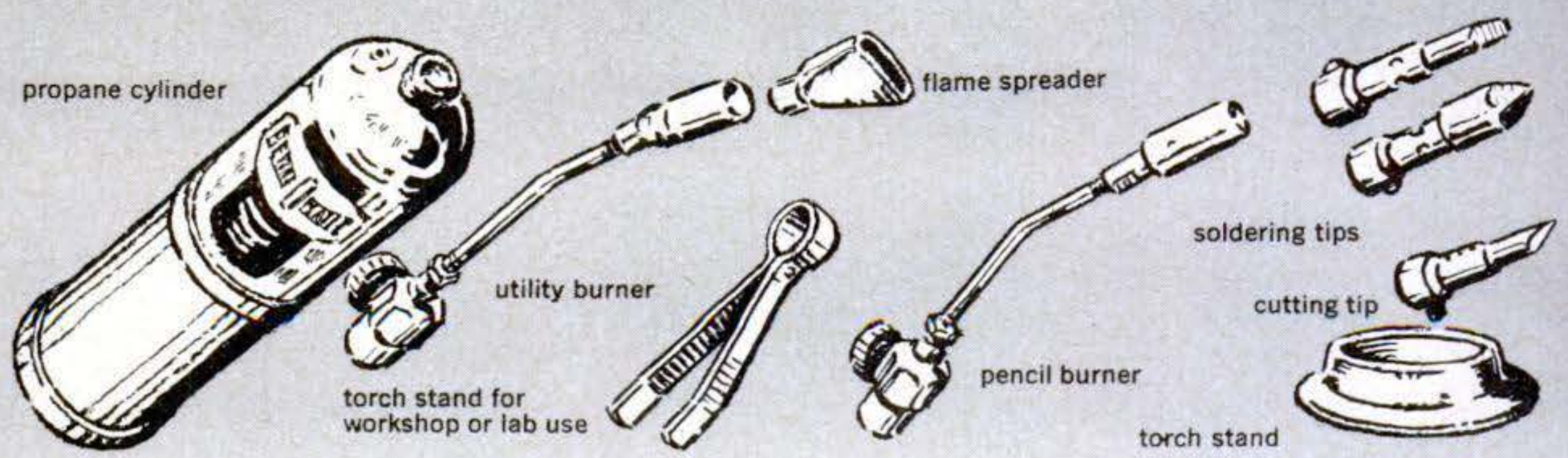
The "genie in a bottle" is propane gas. Under pressure, propane is a liquid; therefore a great amount can be stored in a small container. When it is released as a gas it expands over 400 times its size, in volume. Flowing through an opened BERNZ-O-MATIC burner unit, this gas is blended with just the right amount of air for an intense, smokeless flame.

The BERNZ-O-MATIC torch is fast and easy to operate. It is Underwriter Laboratories approved and so safe it can be shipped through the mail. It lights instantly at the flick of a match, and the precision BERNZ-O-MATIC valve provides fine and dependable flame control.

The cylinder. Here, BERNZ-O-MATIC engineering gives you big dividends. The tough but conveniently-light cylinder has a self-sealing valve that pops shut when you thread off any one of three burner units to replace it with another. This means no loss of fuel when you interchange the cylinder among various BERNZ products.

Despite these features, BERNZ-O-MATIC cylinders are so inexpensive you can discard them when the propane runs out, and be back in business with a fully-charged new cylinder, available at hardware stores everywhere.

Burner units. BERNZ-O-MATIC's interchangeable burner units are made of lifetime brass. Two of them—the utility type, which delivers a "blow-



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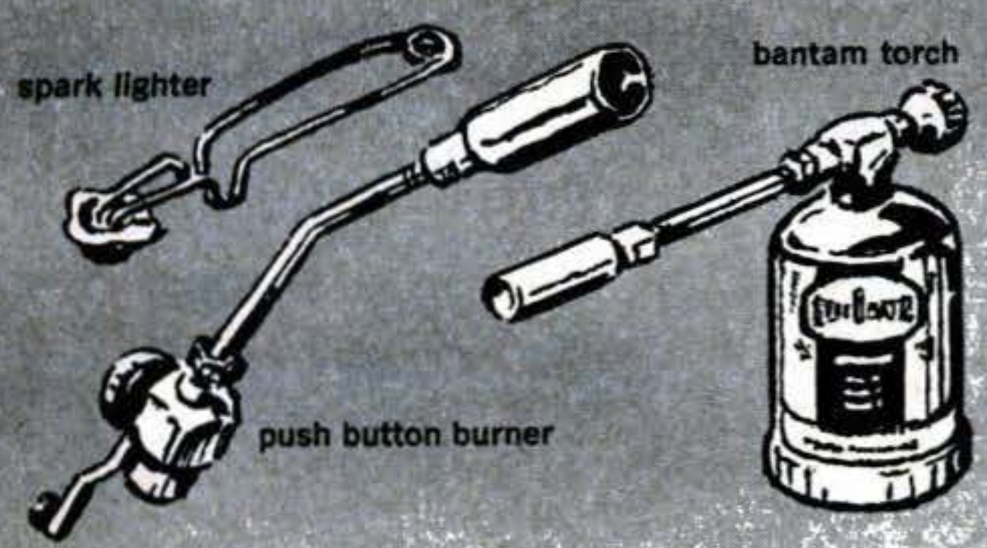
torch" flame for heavy work, and a pencil type, used for pin-pointing heat on finer work—have identical valve bodies and burner tubes. This lets you convert the torch, simply by interchanging burner heads and orifice bodies. A third burner unit, the push-button type, offers the convenience of any size flame, simply by varying thumb pressure on its control valve.

For the artisan or hobbiest who goes for very small work, BERNZ-O-MATIC makes a Bantam Torch with a cylinder half the size of the regular Master Torch type, and a burner especially suited for such projects.

Accessories. A flame spreader that attaches to a utility burner head provides a wide flame for such work as burning off paint, antiquing furniture and laying asphalt tile. Either a large or a small soldering tip accessory, fitted with a pencil type burner head, gives you a constantly-heated iron that you can use anywhere—no need for electric power or a troublesome extension cord. A cutting tip, available for the same head, makes a breeze of cutting tile, wood-burning, and removing putty from window sash for re-glazing.



Handiest tool you've ever owned!

No workshop is complete without a safe BERNZ-O-MATIC Propane Torch! You'll reach for it constantly . . . it makes otherwise difficult or impossible jobs a snap to do quickly and easily. As easy to light as a cigarette, your BERNZ-O-MATIC Torch delivers a blue-hot flame that's instantly ready to help you install asphalt tile, thaw frozen pipes, remove old paint, solder tools, toys, copper tubing—practically anything.

Your BERNZ-O-MATIC Torch is clean and safe. There's no filling, no spilling, no pumping, no priming! The UL-tested burner head simply screws onto the safe, disposable cylinder. Open the valve, light, and you're ready for action. And every job—big or small—costs only pennies. A BERNZ-O-MATIC fuel cylinder lasts up to 15 hours with a pencil type flame. Inexpensive replacement cylinders are available at any hardware store.

BERNZ-O-MATIC torch units start as low as $6.95 . . . come in a number of kits with a different selection of attachments: soldering tip, pencil flame burner, utility burner, flame spreader—all so reasonably priced you'll be amazed at the precision engineered quality.

Your hardware dealer will be glad to demonstrate the BERNZ-O-MATIC torch—the most do-everything tool in your workshop.

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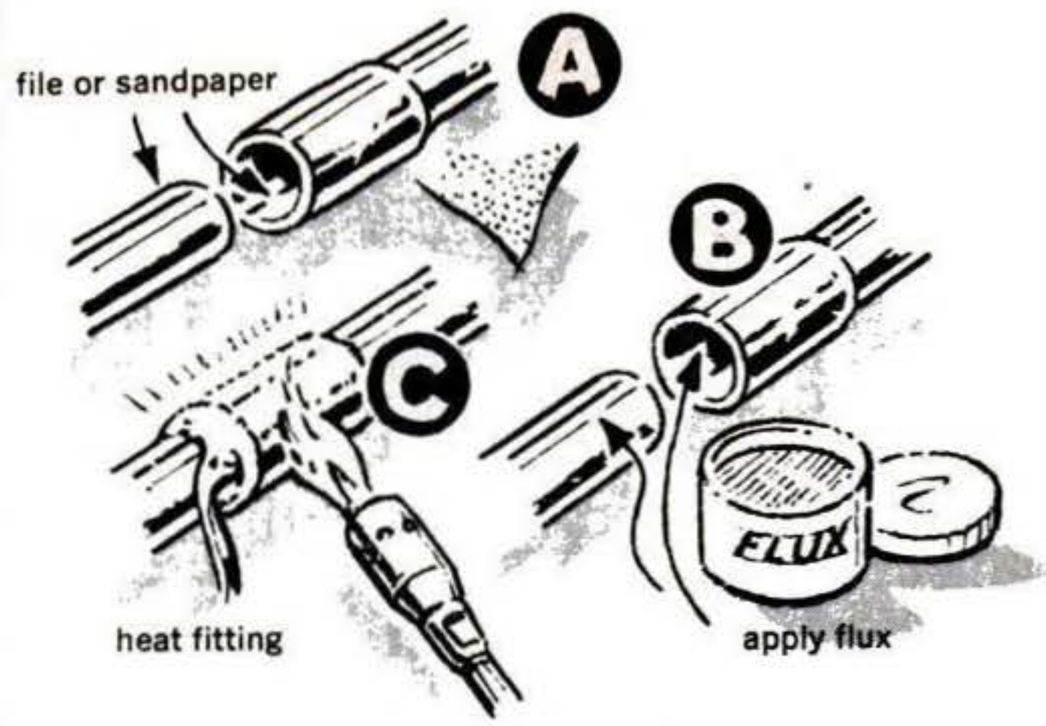
Soldering facts

What solder is. All solders fall into two classes—soft and hard. Soft solders (blends of tin and lead), melt at low temperatures, making them easy to handle. Conveniently, too, they adhere to a number of common metals, including copper, brass, tin and steel.

Hard solders are alloys of such metals as copper, lead, tin, bismuth, gold and silver. They melt at comparatively high temperatures and are tricky to work with if their melting points approach that of thin metal stock, or where working temperatures cause heavy oxidation, as in the case of aluminum. On the other hand, they produce very strong joints.

What makes solder stick. A chemical action. At a relatively low temperature, the solder dissolves the surface metal on the parts being bonded, and blends with it. *This blending can't take place unless both surfaces are completely free from corrosion, rust, grease, paint, or any other coating.*

Why you must use flux. The moment heat is applied to the work area, a new oxide starts to form. This would prevent the chemical action of solder, unless there was a way to float it off. That's what flux does. Use acid type flux for heavy soft soldering jobs, and resin type for all electrical connections. Manufacturers of hard solders offer complimentary fluxes for their products.



Soldering with

Sweating copper pipe fittings. Sweating copper pipe and tubing with a BERNZ-O-MATIC torch is a simple operation. Now you can install or repair water lines, automatic washers and dryers, automatic hot water heaters, etc.

First wire-brush or sandpaper both the pipe end and the inside of the fitting thoroughly. Next, apply flux to these areas. Then insert the pipe in the fitting. Direct the flame on the fitting near the joint until the metal becomes hot enough to melt solder at contact. Apply solder to the joint and continue heating until it flows smoothly around the joint and fills it completely. Finally, scrub off all flux residue.

Sheet-metal work. Whether you're applying a patch to a gutter, or making a copper planter, it's important to remember that solder, itself, is not a strong material. You can't make a good joint simply by bringing two metal edges together and running a ribbon of solder over the seam. Instead, use either a lap joint, or, where an assembly will be subjected to stress

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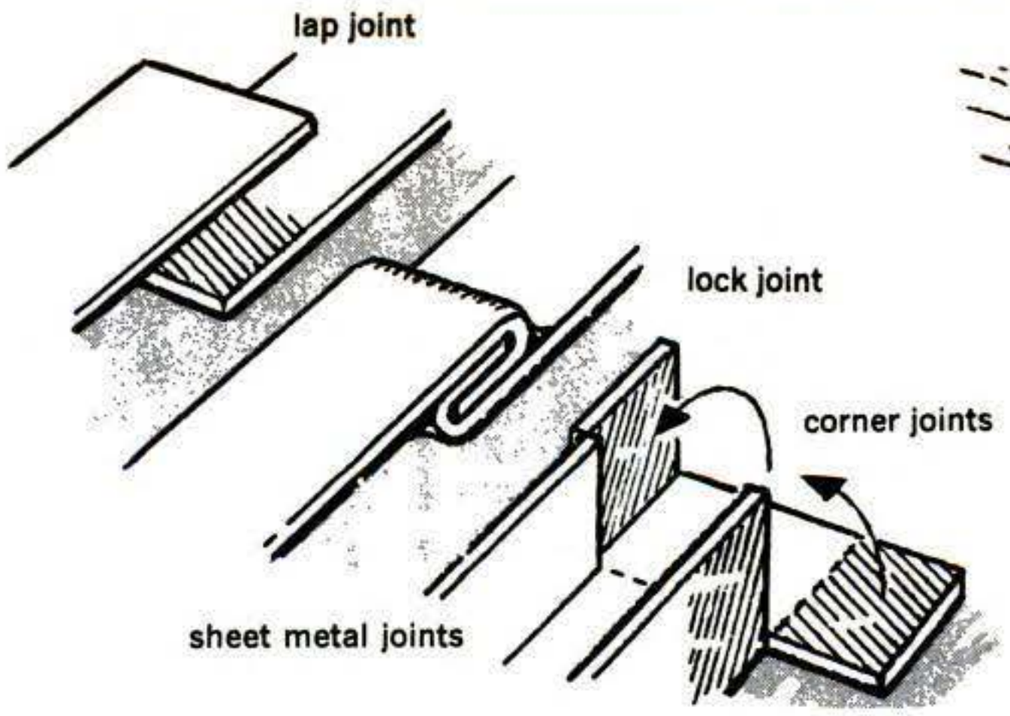
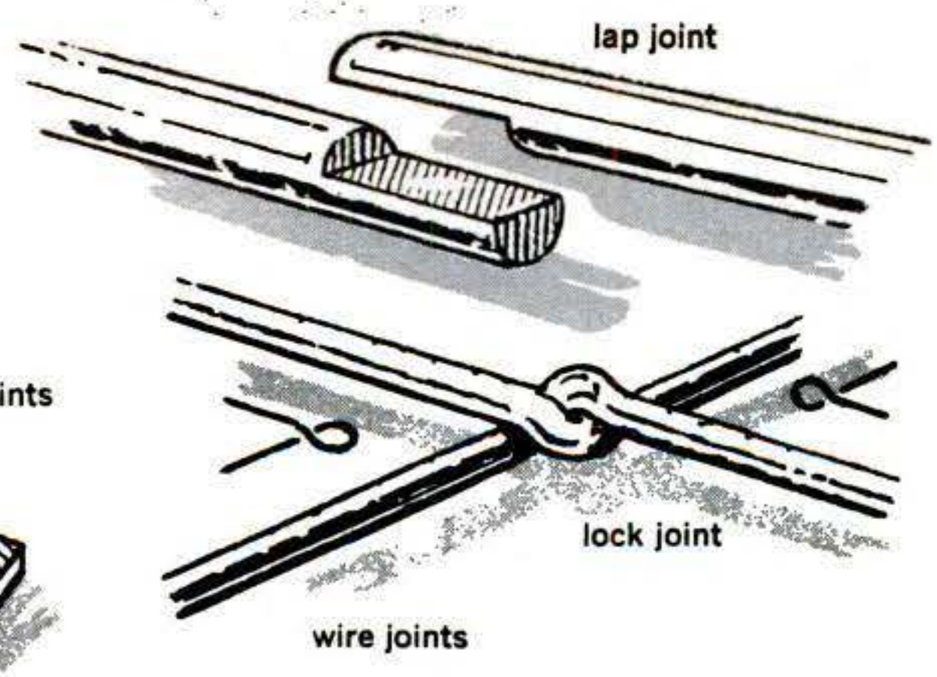




Bernz-O-Matic torches

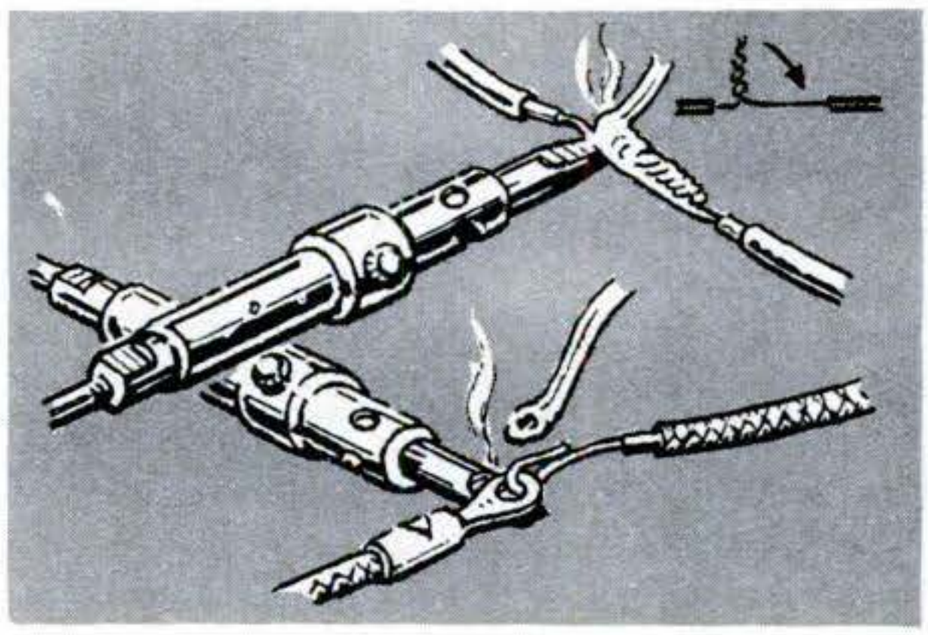
or vibration, a lock joint made by folding back the edges of the stock and interlocking the two "U" sections. With lap joints, spread flux over the metal areas to be mated, and coat them with solder. Then lap the parts and run either a soldering tip or the direct flame of a burner over the top of the joint to fuse the coatings. To solder lock joints, clean the contacting surfaces before folding and apply flux. Then, with the parts interlocked, flow solder in, just as you would to sweat a pipe joint.

Handling rod and wire. Rod assemblies are used extensively for decorative lamps, brackets, room dividers and other house furnishings. Wire sculpture, too, is very popular, today. A BERNZ-O-MATIC torch is a natural for both crafts.

When bonding the ends of rod and heavy wire, use lap joints made by filing halfway through each end section. Apply solder to the resulting flat areas, place these "tinned" surfaces together, and sweat them with the flame. Where rods cross, notch both at the point of intersection and, again, sweat solder the resulting lap joint. Or, if considerable strength is needed, give each rod or wire a half turn around the other and flow solder into the connection.

Where splices in copper, brass or steel won't be subjected to any great strain, soft solder is fine. But for really firm bonds, use hard solders. Here a BERNZ Master Torch will let you handle steel rod of up to quarter inch diameter. With a Push Button Torch you can go as high as half inch.

Electrical connections. Remove all traces of insulation and oxidation for a good electrical and physical connection. To splice wires, wind the ends



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Using soldering tips

Tinning. No soldering iron will work unless the faces, or "flats," of the tip are covered with a thin coating of solder. This "tinning" keeps oxide from forming on the hot copper, where it would prevent the transfer of heat to parts being soldered.

To tin a new BERNZ-O-MATIC soldering tip, file or sandpaper each flat until the copper shines. Next, attach the tip to the torch and heat it until the copper just begins to darken. Then rub either a bit of solder covered with flux, or flux-core solder, lightly but thoroughly over each flat. Wipe off the excess with a cloth pad.

Flame adjustment. Use a small flame at all times. A large flame is unnecessary, wastes fuel, hastens the need for re-tinning, and shortens the life of the tip.

Warm-up. After lighting the torch, wait until the soldering tip hisses at contact with flux before using it. This takes about 30 seconds.

Applying flux to the work. Use a bit of wood or an old bristle brush to dab flux directly on the part to be soldered. Never dip a soldering tip in a container of flux. This not only leaves a damaging residue on the copper, but breaks down the flux in the can.

Using the soldering tip. Don't try to heat the metal parts with just the point. Always press one of the flat surfaces of the tip firmly against the work.

together and bend the tips back. Then, holding resin-core wire solder against one side of the joint, apply heat to the other until the solder melts and binds the whole connection.

Terminals for soldered connections usually have a hole, or "eye." Bend a hook in the end of the wire, place it through the eye, and solder.

A pencil flame is good for large electrical connections. For jobs in crowded quarters, a small soldering tip is the right tool. Work surely and fast. Prolonged heat will break down the flux, weaken wire, and possibly damage nearby electrical components.

Leading

Stopping gutter leaks. When a joint in a copper or galvanized steel gutter leaks, "leading" is the best and easiest fix-it. By definition, this means covering, filling, or framing metal with lead or solder. In other words, you don't re-solder the joint; you simply flow a waterproof patch of solder over the section that leaks.

Start by wire-brushing or sanding all around the area until the metal is

shiny bright. With galvanized steel you must not only remove every trace of paint and rust, but rough up the zinc coating until you've bared the steel beneath.

Next, cover the cleaned surface with acid flux, and place the end of a piece of bar solder against the joint, well back from the section that's opened up. Apply the brush flame of a BERNZ-O-MATIC utility burner to the joint, just ahead of the solder. Wait until the heat of the metal has melted a fair amount of solder; then move both flame and solder along the seam, slowly enough to leave a continuous, joint-spanning patch. Finally, scrub off the flux residue.

Choosing the right soldering and brazing alloys

TYPE OF SOLDER OR ALLOY	Stainless steel solder and flux	General-purpose acid core solder	All-purpose resin core electrical solder	Aluminum brazing alloy and flux	Silver solder and flux
APPLY SOLDER OR ALLOY WHEN:	Solder flows freely on contact with heated metal	Solder flows freely on contact with heated metal	Solder flows freely on contact with heated metal	Flux becomes a clear liquid	Flux becomes a thin, clear liquid and forms dull red
For metals below use solders or alloys marked "X" at right **ALUMINUM** For strength in joining sheets, sections, etc.				X	
CHROME PLATE For trim, when on steel, brass, copper or nickel alloys. (Not on die castings.)	X				
COPPER OR BRONZE For electrical equipment, or fittings, tubing, utensils, etc.		X	X		
GALVANIZED IRON OR STEEL For cans, buckets, tanks eaves-troughs, etc.		X			
SILVER AND SILVER PLATE For jewelry, flatware, etc.	X				X
STAINLESS STEEL For appliances, kitchen equipment, or wherever strength is needed	X				X
STEEL For utensils, pipes, sheets, tool steels, motors, etc.	X				X
UNLIKE METALS Such as steel to brass	Unlike metals with X's in the same vertical column can be joined. For example: Copper and galvanized iron, with general-purpose solder.				

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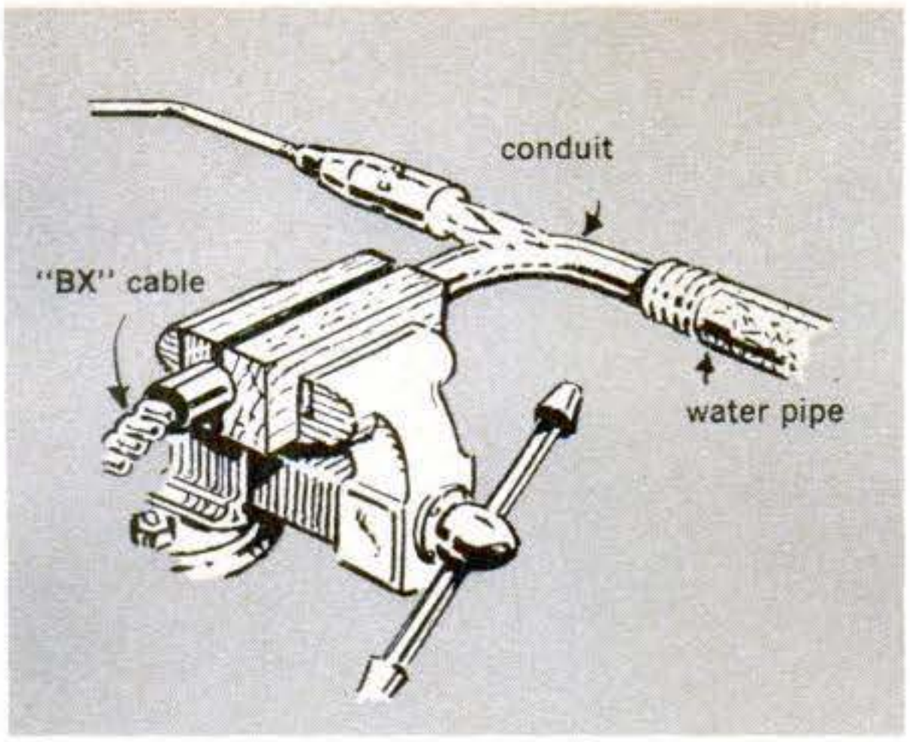


Metal bending

Bending conduit. Whether you're making a 90-degree elbow in thin-wall conduit for electrical work, or using this handy material for a youngster's jungle gym or motor-kart chassis, pre-heating the metal makes controlled bending easy.

First, drill a hole, the same diameter as the conduit, in a block of wood. Then saw along the centerline, to divide the block into two vise pads. Place these pads in a metal vise, with the conduit between them. Next slide a length of BX cable through the conduit to prevent kinking.

Apply the flame of a BERNZ-O-MATIC utility burner to the section to be bent. Move it slowly back and forth for several minutes, distributing uniform heat. Then slide a piece of heavy water pipe over the free end of the conduit, and lever it to form the bend. Quench the heated section in water and withdraw the BX cable.

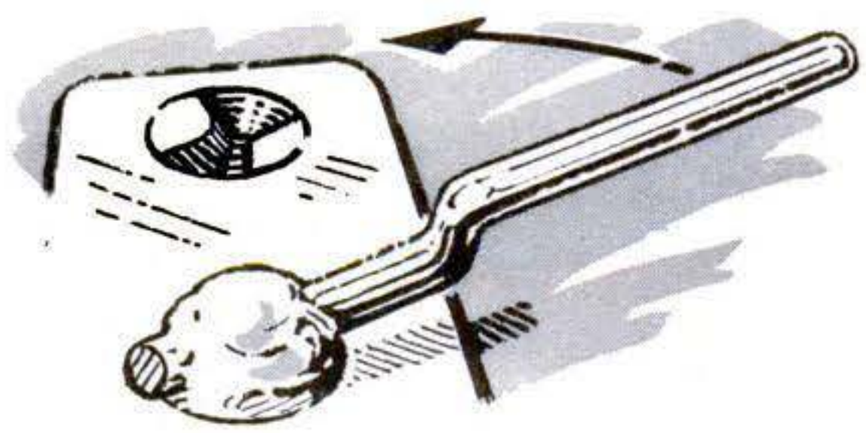
Forming ornamental iron work. Making a heavy-duty bracket for an outdoor lamp, or shaping porch railings? Here again, heating takes the place of brawn. Clamp the bar stock in your vise, with a wood block on either side to prevent heat carry-off. Then pour on the flame of a utility burner until the section to be bent turns a dull red. Coax it into the desired curve with levering or hammer blows.

Loosening stubborn parts

Parting threaded pipe joints. When pipe or chain wrenches won't do the job alone, the flame of a BERNZ-O-MATIC torch is your best ally. The trick is to expand the fitting with heat and, at the same time, prevent the pipe from expanding. Soak a large rag in cold water and wrap it around the pipe. Then direct a high flame at the fitting. When the latter is thoroughly heated, go back to work with the wrenches.

Freeing bolts and nuts. Direct the flame at the sides of the nut. A minute or so of this persuasive treatment is all that's usually needed to put the wrench back in business.

Backing out screws. When a slot in a machine- or drive-screw head is so badly damaged it offers no bearing area for a screwdriver, try this old jewelers' trick: scrape the head until it's shiny bright. Then bend an offset



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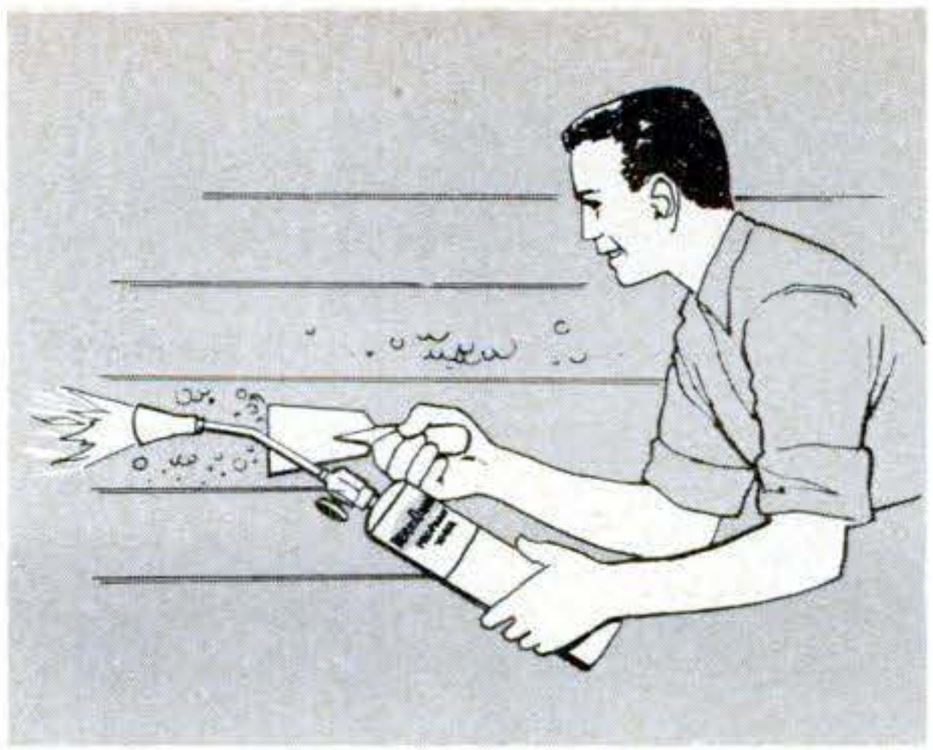
in a bit of brass rod. Solder the resulting lever to the screw head with a BERNZ-O-MATIC soldering tip, and crank the screw out.

Removing putty and paint

Preparing for re-glazing. Chipping out old putty with a knife is slow work, and may result in damage to the sash. Instead, remove putty the easy, safe way. Adjust a BERNZ-O-MATIC pencil type burner for the lowest possible flame and move it slowly along the putty, following up with a sharp scraper to work the old putty out as it becomes pliant. Better, if you have a cutting tip accessory, use this for simultaneous heating and scraping. Either way, keep the torch moving to avoid scorching the wood. When the old putty has been removed, apply a coat of linseed oil or an outside primer. This fills the pores of the dried-out wood and makes for a good new putty bond.

Burning off paint. This is the professional way to bare wood for repainting, when older coats have blistered, peeled, or alligatored. First, find where the loose paint starts by prying with a knife. Then go to work with a flame spreader accessory on a utility type burner, and a scraper with a long blade.

Work from right to left, if you're right-handed, aiming the flame just ahead of the scraper. Always keep it moving and hold it at an oblique angle (never at right angles) to the work. Check areas you've just worked over



for any sign of smouldering, and never burn off paint on windy days.

Asphalt tile

Laying asphalt floor tile. First, make a scale floor plan, to see how the tiles can be laid out in the most uniform way, and with a minimum of cutting. Apply asphalt cement to one section at a time, using a notched trowel spreader. Wait until the adhesive is tacky—20 to 30 minutes.

Heat the undersurface of each tile with the flame of a utility burner before positioning it. When it becomes slightly pliant, lay it carefully in place (don't slide it around). While it's still warm, press it firmly down to conform to the contour of the floor.

Do each floor section the same way, working from the middle of the room out to the walls.

Cutting tile. When you must cut asphalt tile to fit a final row against a wall, apply a border, or work around pipes or other obstructions (preheating is a must) to avoid cracking the brittle material. One cutting method is to run the torch over the back of

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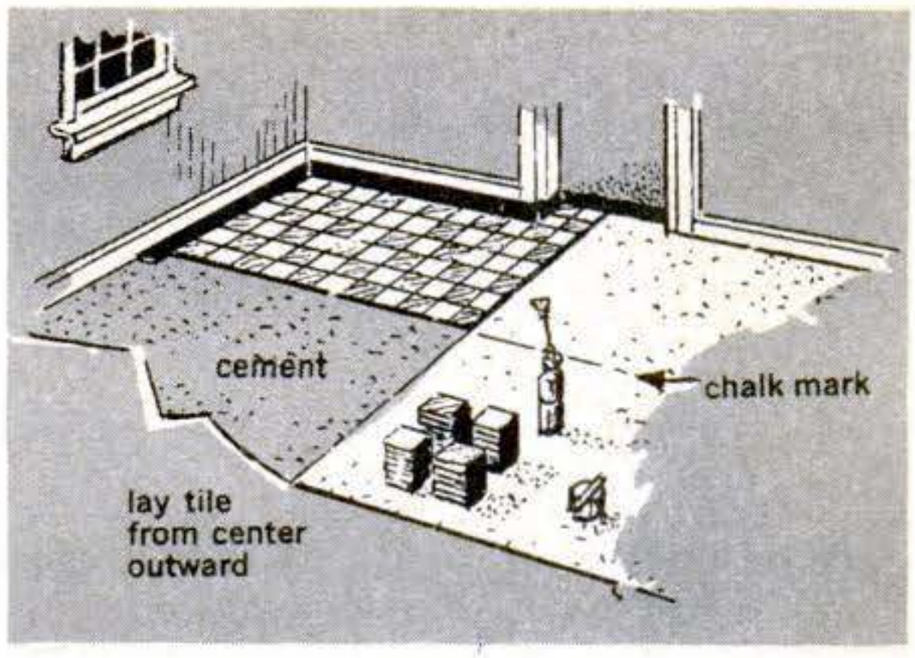


each tile and, when it's sufficiently pliant, trim it with tin snips. A somewhat better way is to scribe the surface with a linoleum knife, then heat the back and crack along the scribe line by bending the excess downward. This way the edge isn't compacted, as it is with tin snips.

Still better, use a BERNZ-O-MATIC tile-cutting accessory, attached to a pencil type burner. With the flame adjusted low, and the knife edge heated, run the blade slowly along a straight edge laid on the cut line.

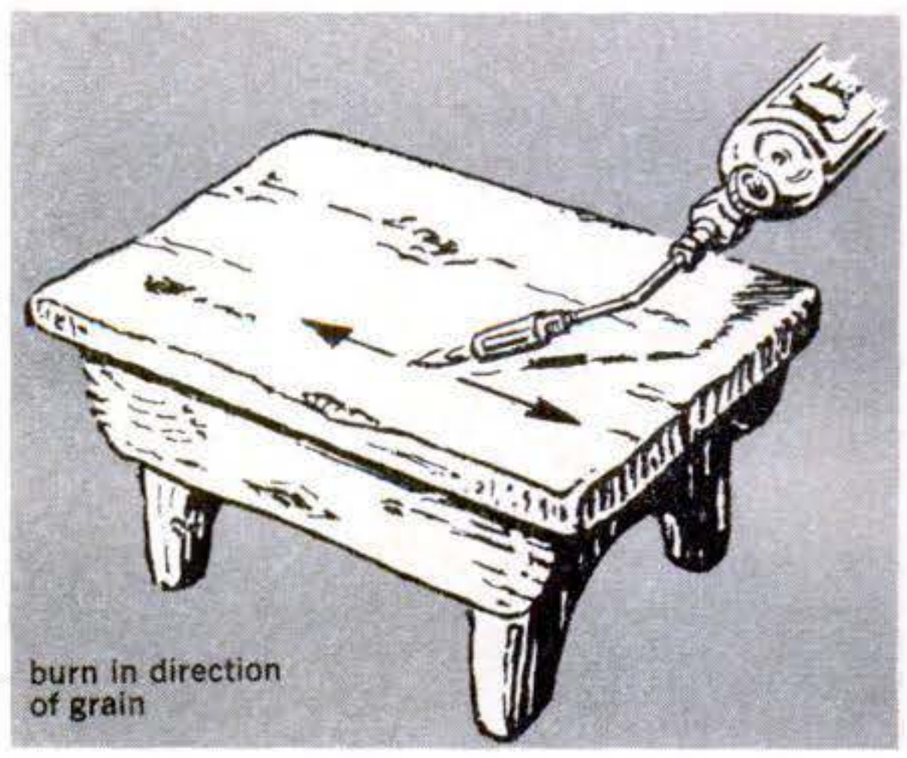
Replacing a damaged tile. Cut around the edges of the cracked tile with a linoleum knife, to the level of the sub-floor. Then play the flame of the torch around the tile square to soften the adhesive. Remove the tile, either by driving a sharp-pointed pick into its center and prying, or with the suction of a rubber force cup, or "plumber's helper." Re-heat the adhesive until it becomes tacky, warm the undersurface of the new tile, and press it firmly in place.

Leveling tile. Buckled and lifted tile are easy to re-level. Just heat the top surface gently and force the high spots down.

Crafts

Plywood sculpturing. For attractive plaques with pictures or designs pyro-etched into their surfaces, you need no more than a piece of plywood, the desired wood finish, and a BERNZ-O-MATIC torch with a soldering- or cutting-tip accessory. Cut the plywood to shape and trace the drawing or pattern on its surface. Then, using the tip like a lead pencil point, follow along the lines. Finish the surface with shellac or varnish.

Antiquing furniture. Where necessary, remove paint, stain, varnish, wax or other finishes. Sand the wood smooth. With torch adjusted low, move the flame slowly over all surfaces, going with the grain—not across it. To darken knots, direct a pencil flame at them. Or move it in small circles to simulate knots. Create the effect of wear along edges by whittling irregular Vees and scorching them. Finally, give all surfaces a wash coat (half alcohol) and then a full-strength coat of clear shellac.



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Burning

Kindling fires and lighting charcoal. The intense flame of a BERNZ-O-MATIC torch makes fire-starting easy. Use it to kindle hearth fires, and to get quick action with wet and uncooperative leaf and brush piles.

Branding tools. A soldering tip or cutting accessory makes a handy branding pencil. Use it to burn your initials on garden tools, toys and other wood items, for future identification.

Getting rid of insect pests. Taped to a rake handle or a long pole, a BERNZ-O-MATIC torch with a flame spreader attachment destroys wasp, hornet and tent caterpillar nests in short order. Directed at ant hills, it puts an abrupt halt to this lawn nuisance.

Thawing

Thawing frozen pipes. Open the faucet that doesn't deliver water. Starting there, work back slowly along the line with the flame of a utility burner, until a free flow of water is restored. Never begin at some intermediate point, or you may burst the pipe. Also avoid turning the flame directly on soldered joints and, where nearby studs, house sheathing or wallboard might be scorched, hold a piece of sheet metal or asbestos board behind the pipe, to act as a shield.

Freeing car locks. First try using a torch-heated key to thaw the lock. If a number of attempts fail, hold the lock cover open with a screwdriver while you direct a small pencil flame at the slot. After a few seconds, try the key again.

Removing ice from masonry steps. Rock salt is tough on concrete and brickwork. Your BERNZ-O-MATIC torch is not. Run the flame over the ice until it loses its grip. Then sweep (don't chop) it off.

Other Household Uses for Bernz-O-Matic Torches

Kitchen

Singeing fowl and game
Browning and crisping fat with steaks and chops
Browning meringue on Alaskas, pies, etc.
Soldering counter top moldings

Basement

Soldering connectors in junction boxes
Repairing plumbing
Patching furnace ducts

Workshop

Repairing tools
Repairing toys and bikes
Soldering electrical parts
Making jewelry
Glass working

Outdoors

Tinning roofs
Soldering boxes to conduit
Burning weeds
Disinfecting trash pails

Garage

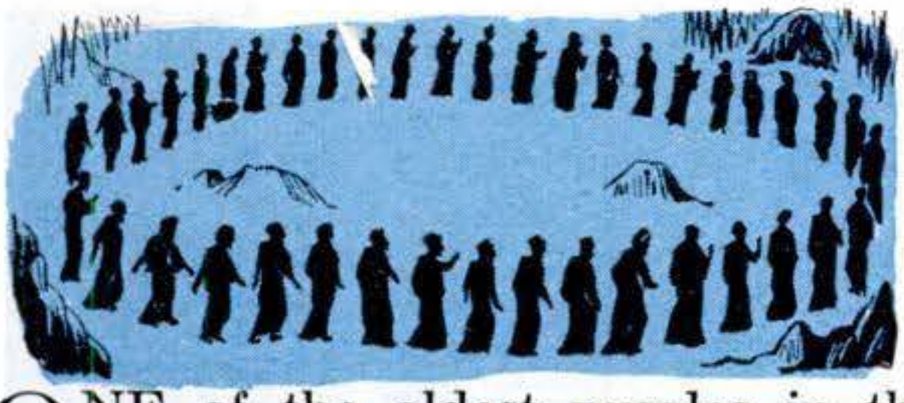
Loosening mufflers and tail pipes
Loosening springs
Soldering connections in ignition systems
Soldering battery cables
Soldering radiators
Loosening wheel lug nuts
Drying spark plugs
Heating water lines
Leading fenders

PS Puzzlers

QUESTION: Do tech students dig puzzles? Answer: Apparently yes. We came across a fine example in an engineering-school magazine recently:

Resting on a marble pedestal in the middle of a terrace is a glass jar. A plumb bob is attached to a thread which is suspended from a cork in the jar. Now, with a minimum of props, can you separate plumb bob from thread without touching jar or cork?

Puzzle of the month



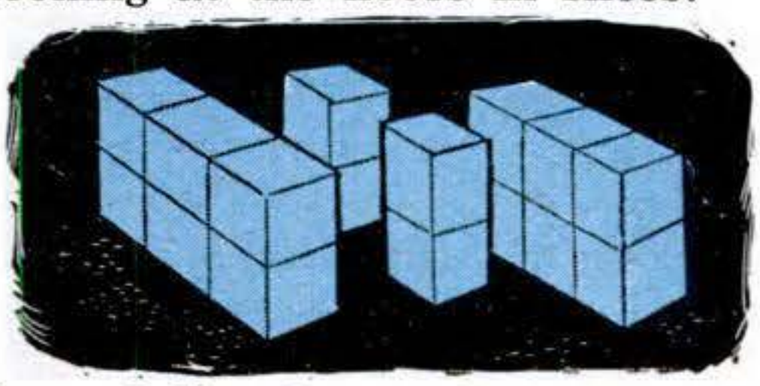
ONE of the oldest puzzles in the world is the "Josephus problem." We leave it to you to decide if it has survived because it has to do with survival: There are so many people aboard a sinking ship—and only one small boat. So many heirs to a fortune—and only one allowed to claim it. So many prisoners taken in war—and only a handful to be spared.

In every case the clever man of the group arranges everyone in a circle, and they agree that after starting at a fixed point every nth person will be eliminated, going round and round again until only the chosen few (or one) are left. The clever man of course arranges himself in the ideal position.

In one version we have Josephus in a cave with 40 other Jews at the time of Roman persecution. Rather than face a worse fate, they decide on suicide. But Josephus and a friend would rather take their chances on survival. So Josephus proposes his circle to determine the order of deaths. Every third person is to be eliminated. Now, where (numerically) did Josephus put himself and his friend? Can you figure out a general rule for such a problem? (Answer next month.)

Answer to last month's P-O-T-M. Find the number and placement of a group of boys who live on the top two floors of a dormitory (eight rooms per floor), under conditions that every room must be occupied; there are twice as many on the top floor as on the second; there are always 11 on a side; and after 9 boys have missed the bus home, the remaining group can still arrange themselves satisfactorily.

Find minimum and maximum figures by looking at the floors in slices:



The end slices have to have 11 each, and since there must be at least one boy in the remaining four rooms, the minimum is 26.

Now look at the front face. That too must total 11. Now fill the corners with just one boy each—then that leaves a maximum of 7 for the middle two rooms. Same for the back face. So we get a maximum of $11 + 11 + 7 + 7 = 36$.

But the top floor has twice as many boys as the second floor, which means the total must be divisible by 3. And 36 is the only multiple of 3 big enough so that when 9 is subtracted from it we still remain within the lower limit possible. So 36 must be the original total, 27 the second.

The 27 must be arranged 18 on the top floor, 9 below. On the lower floor, that means a boy in every room except one, which has two boys. Intuition suggests we put the two in the middle:

1	2	1	← **second floor**	3	1	3
1		1		2		1
1	1	1	**top floor** →	3	1	4

Now the 36 that we started with must be arranged 12 and 24. Considerations of symmetry lead to:

1	2	1	← **second floor**	1	5	1
2		2		5		5
1	2	1	**top floor** →	1	5	1

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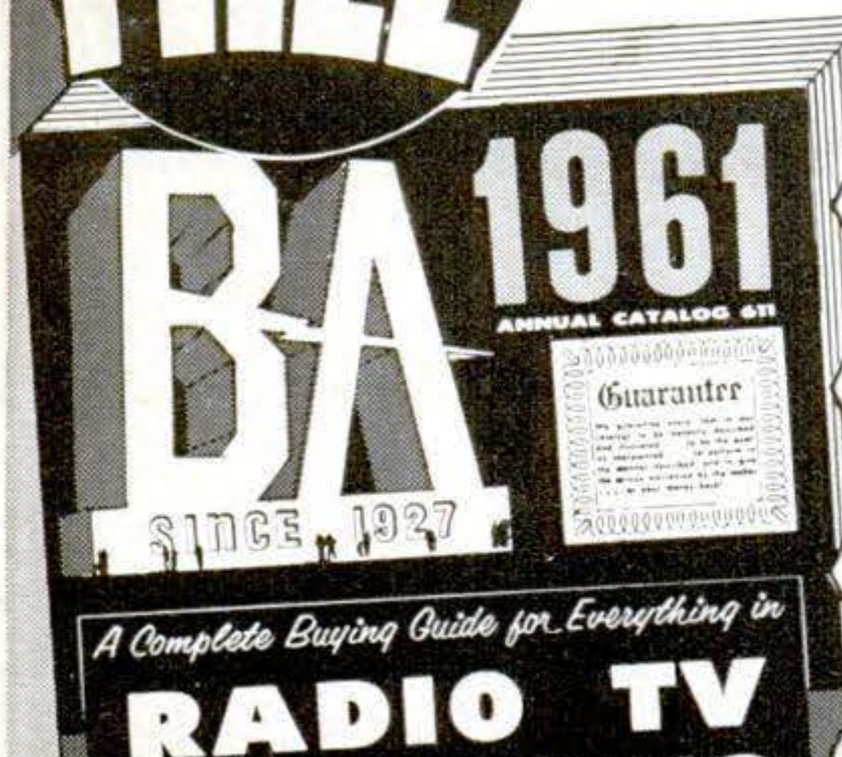

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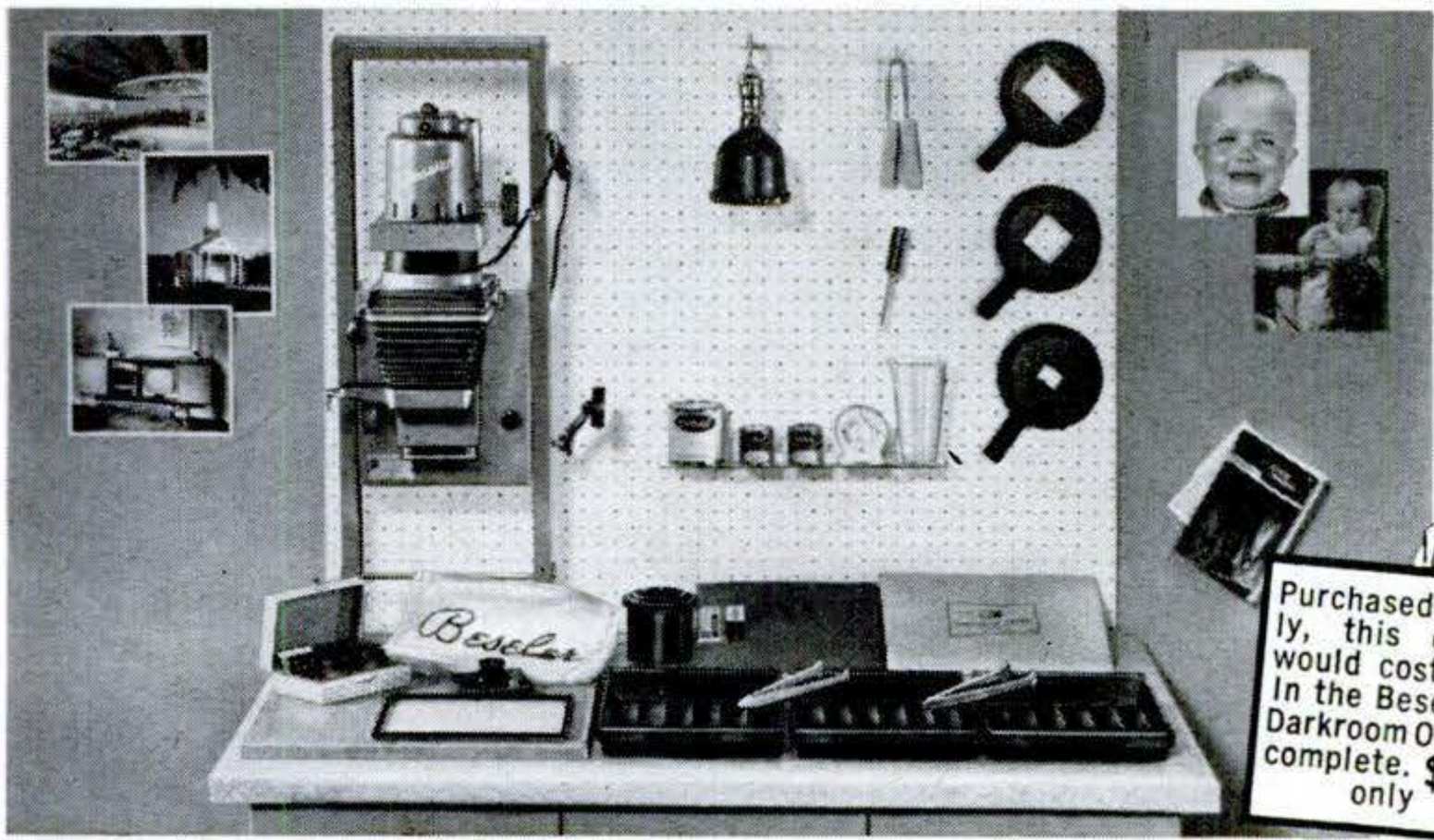

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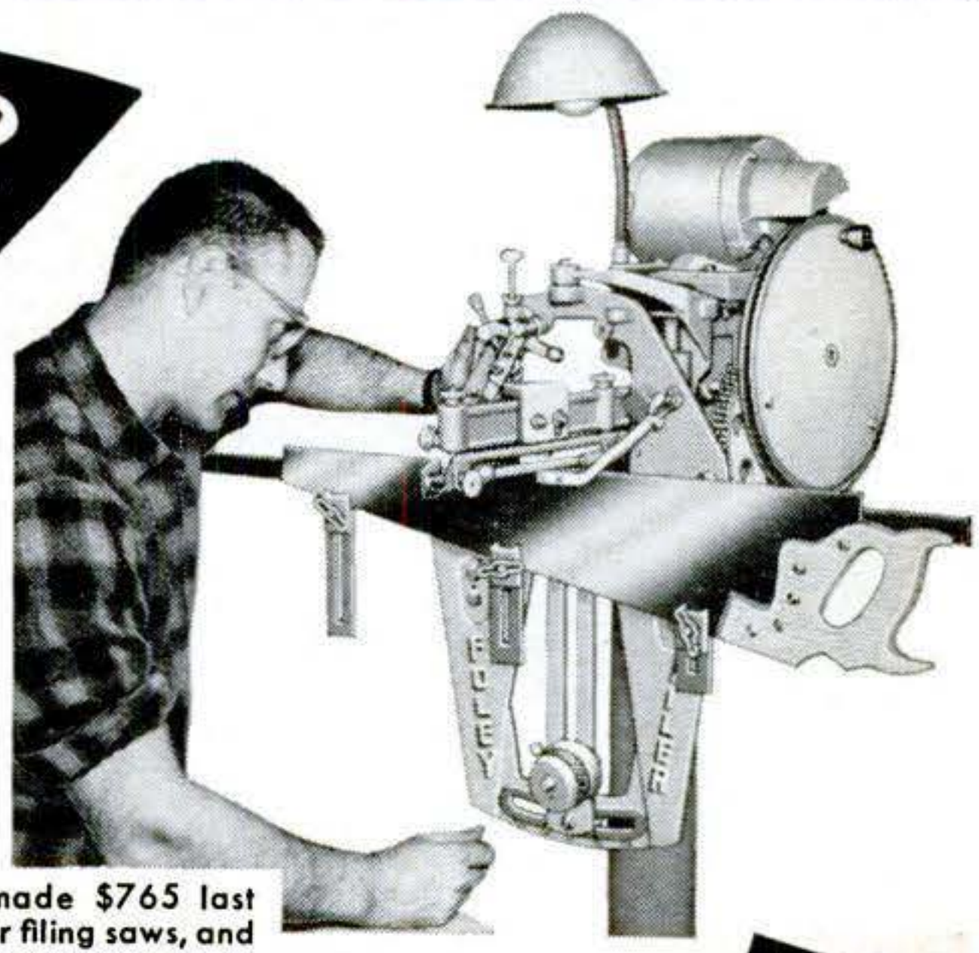

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Ford Starliner, driven by Karol Miller, races across Bonneville Salt Flats.

Ford Starliner sets record of 157.9 m.p.h. with Champion spark plugs!

This is a lot faster than *you'd* want to drive. But it shows you the kind of performance Champion spark plugs deliver.

This was a *standard* Ford—the kind you can order from your dealer. It used gas you can buy at the pump. And it was sparked by the plugs—Champions—most dealers recommend for *your* car.

Winners of 9 out of 10 major races use Champion spark plugs. Twice as many car manufacturers specify them. New Champions will make *your* car perform better (and save money on gasoline), too! Put in a set every 10,000 miles!

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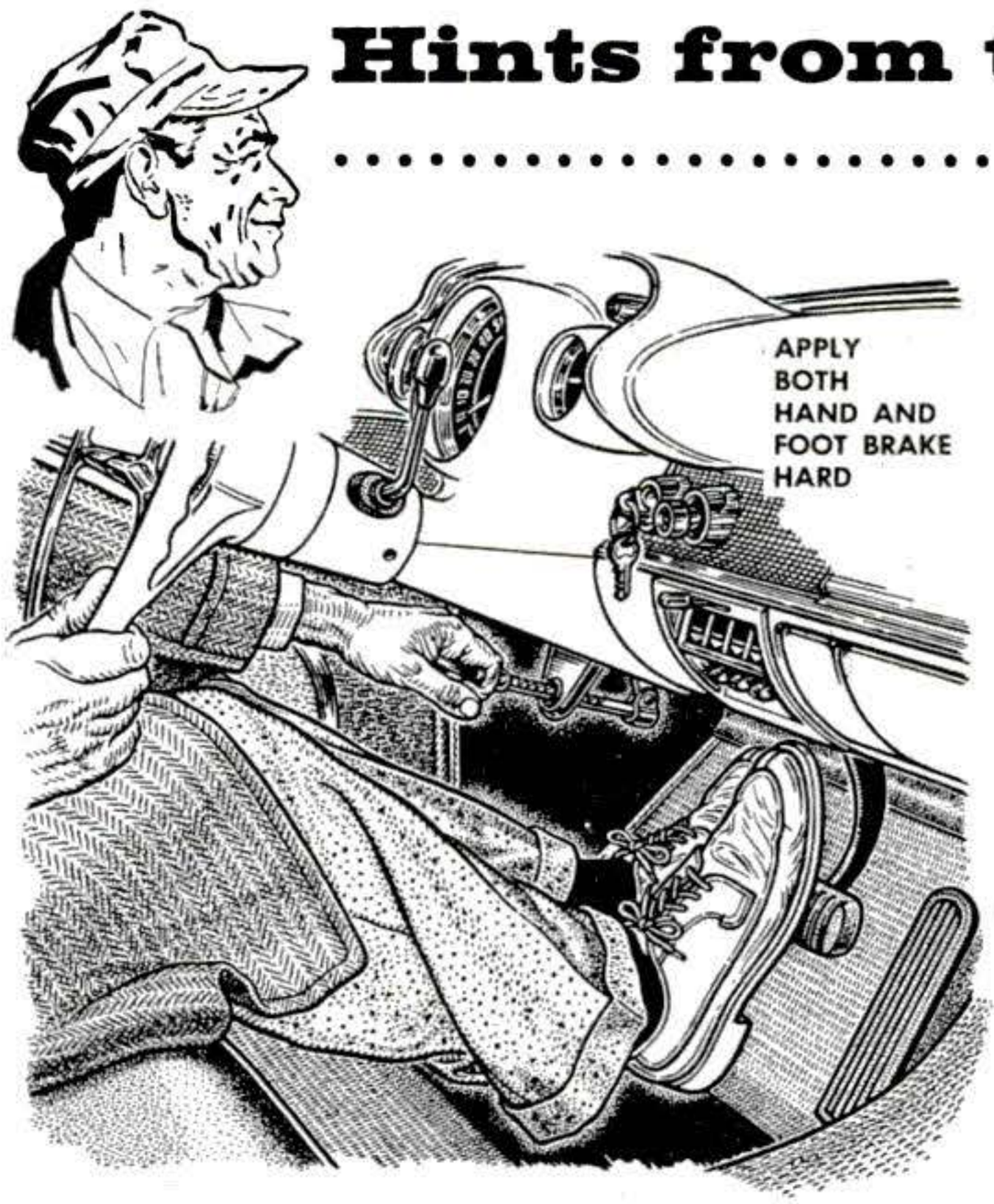
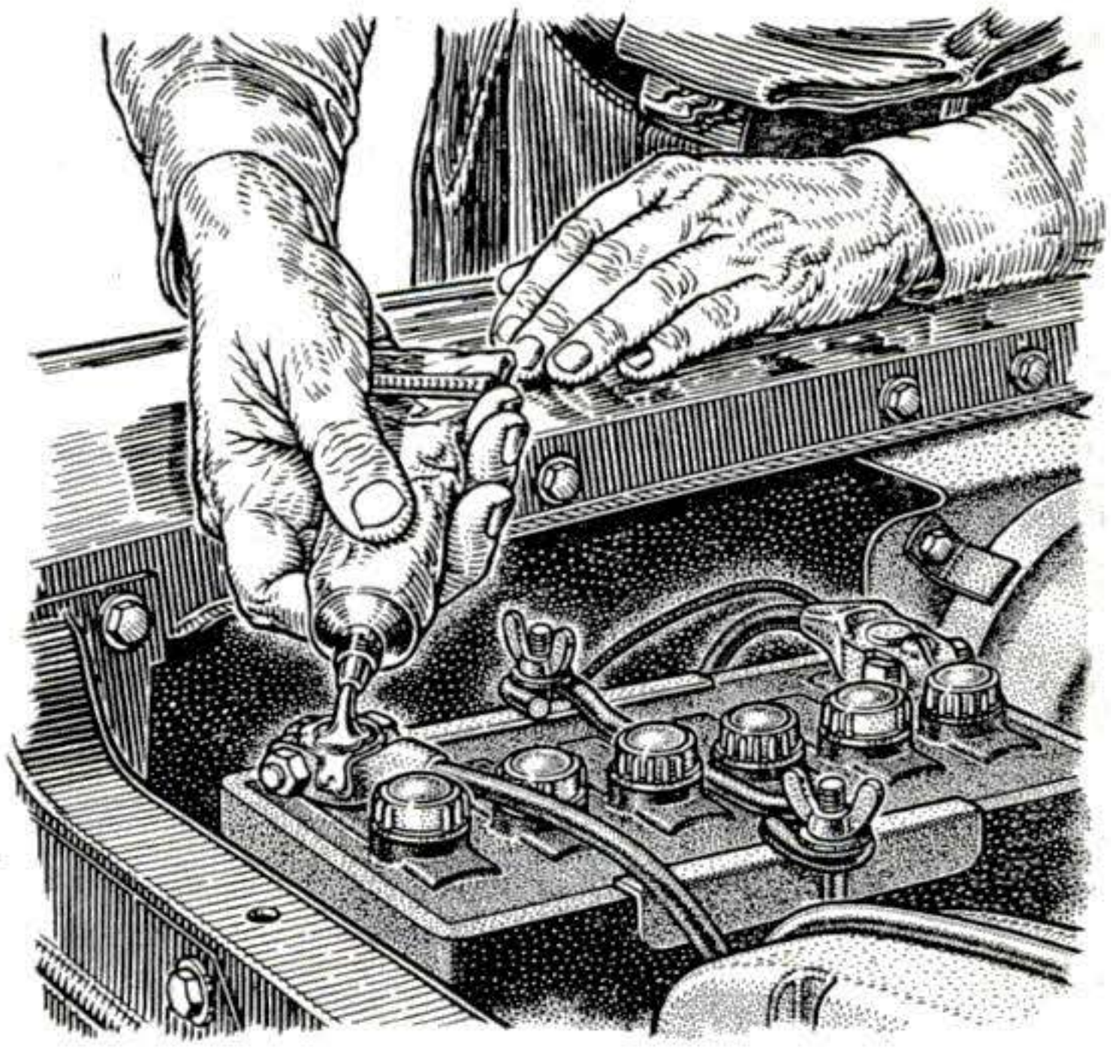
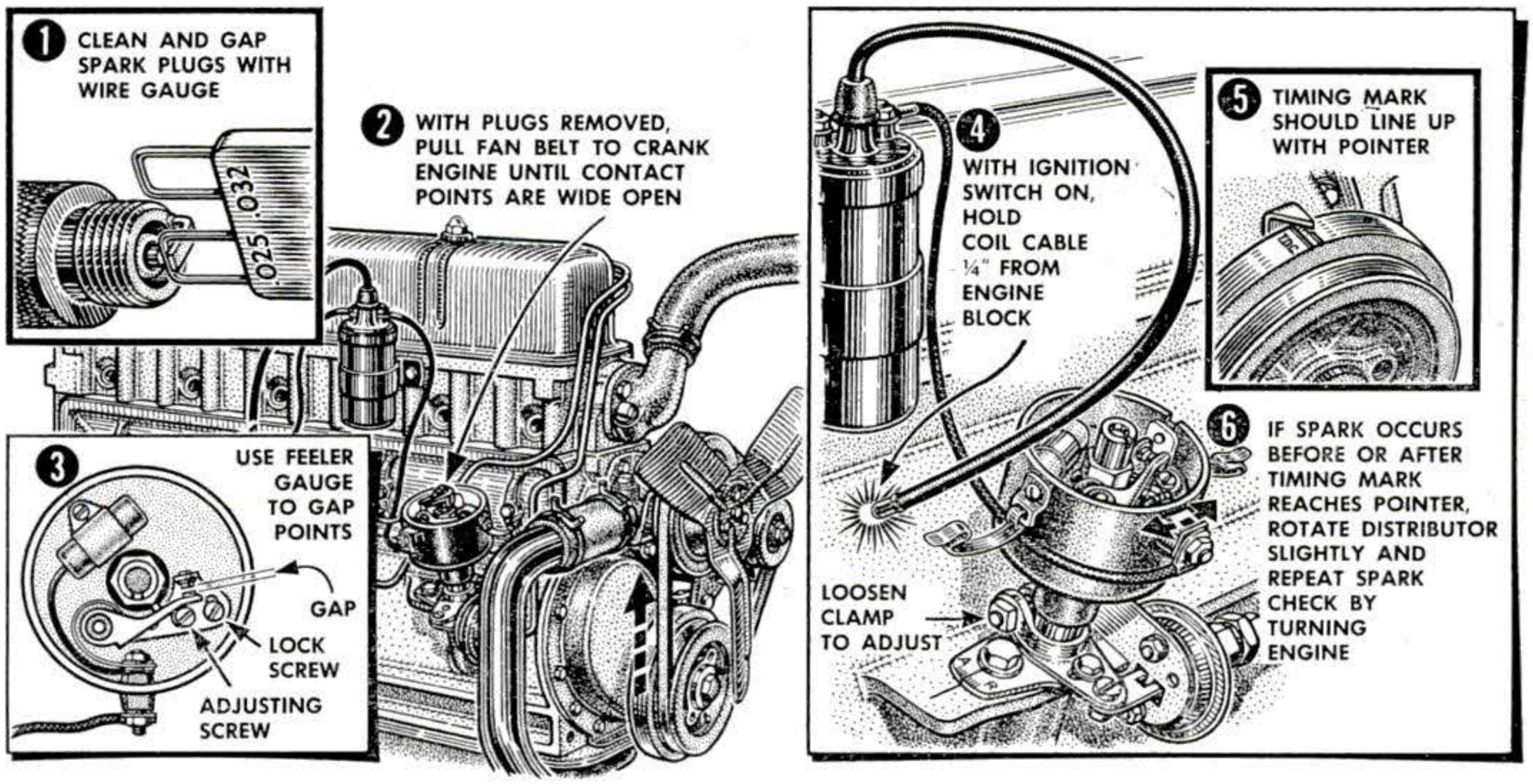
Hints from the Model Garage



A frozen parking-brake cable can sometimes be freed by applying the parking brake with *more* pressure, in combination with the foot brake. This may move the cable just enough to unstick it.



Corrosion at battery terminals can be permanently eliminated by sealing the terminals under a coating of plastic rubber. The rubber can be stripped away when the terminals must be removed.



A tune-up without instruments will keep your car running well between major servicing jobs. Here's how: 1) remove plugs, clean and gap them; 2) crank engine until points are fully open; 3) set points to proper gap; 4) hold finger over No. 1 spark-plug hole until you feel compression, then hold coil cable near block and rotate engine until spark jumps; 5) check timing mark to see if it lines up with pointer; 6) adjust distributor by turning it slightly, and repeat spark test (step 4) until timing mark is under pointer when spark occurs.

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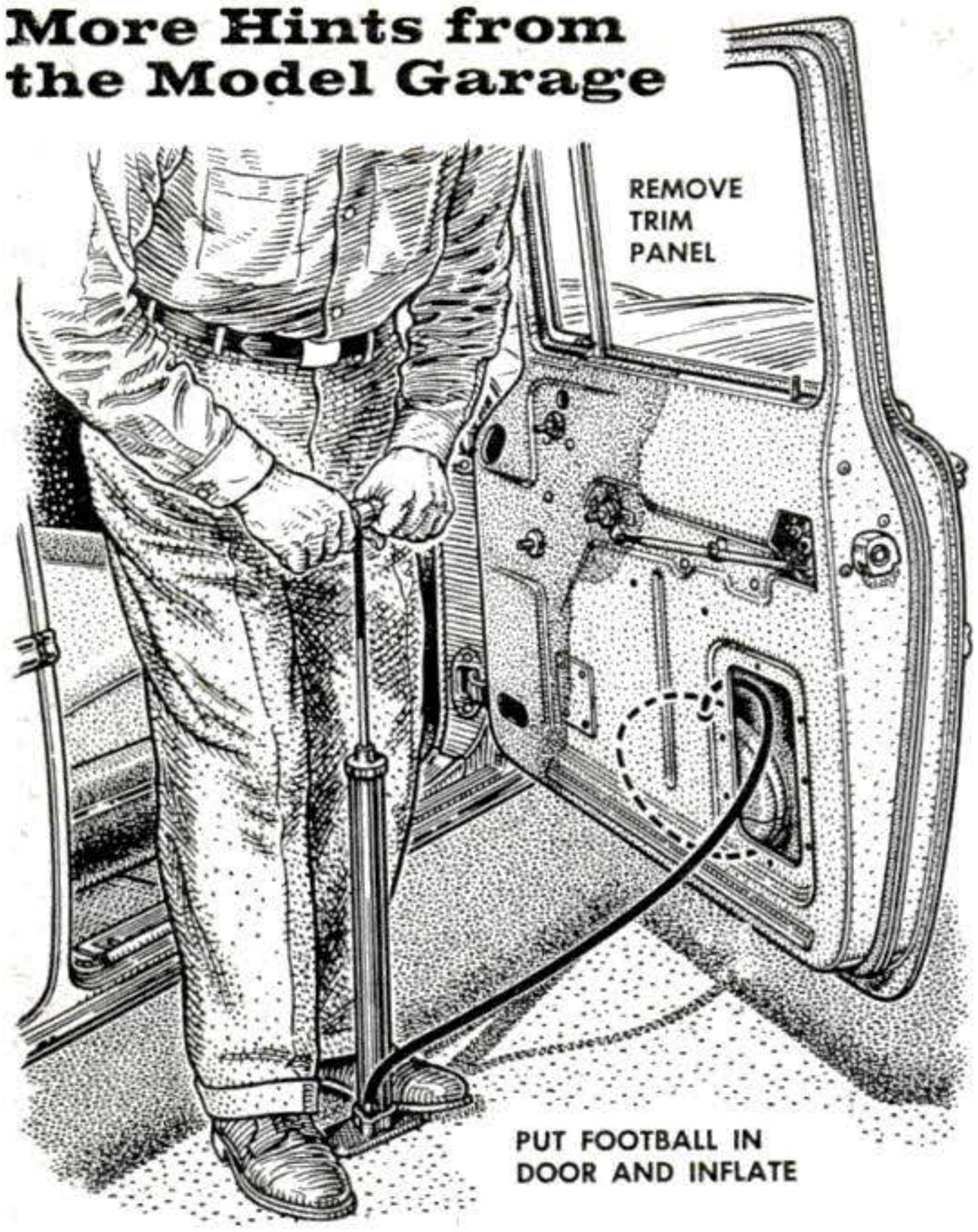
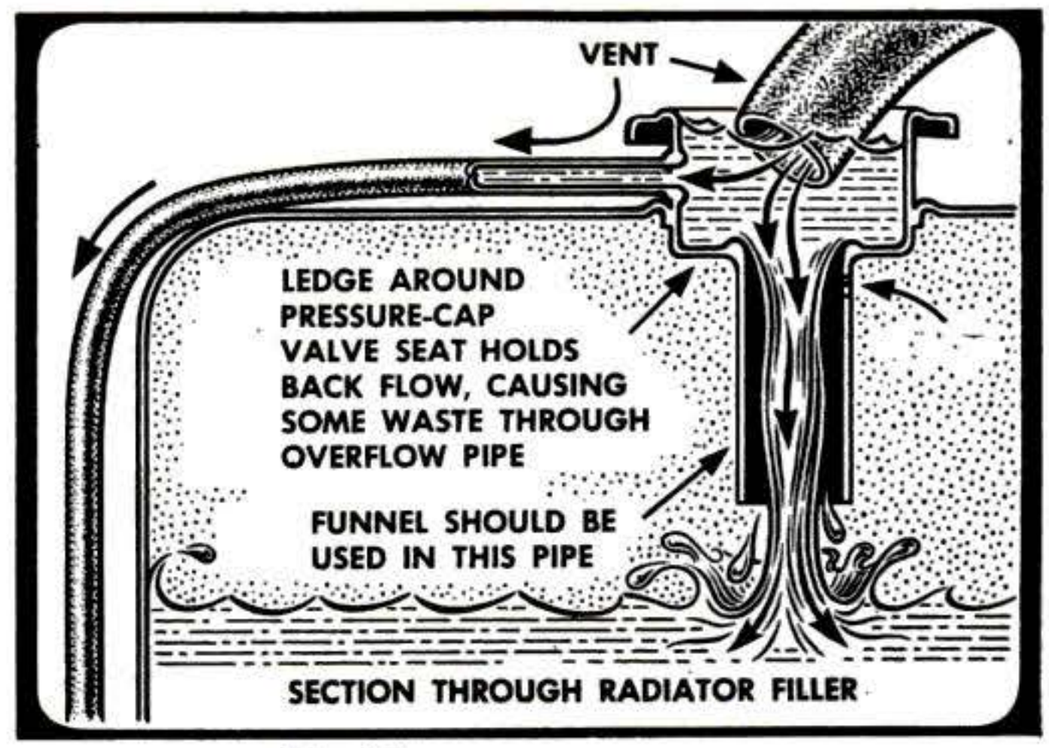
More Hints from the Model Garage



You can push out dents in doors or body panels by placing a deflated football or basketball between the body metal as shown. Pump up the ball and the dent will pop out—sometimes so smoothly you'd never know it was there.



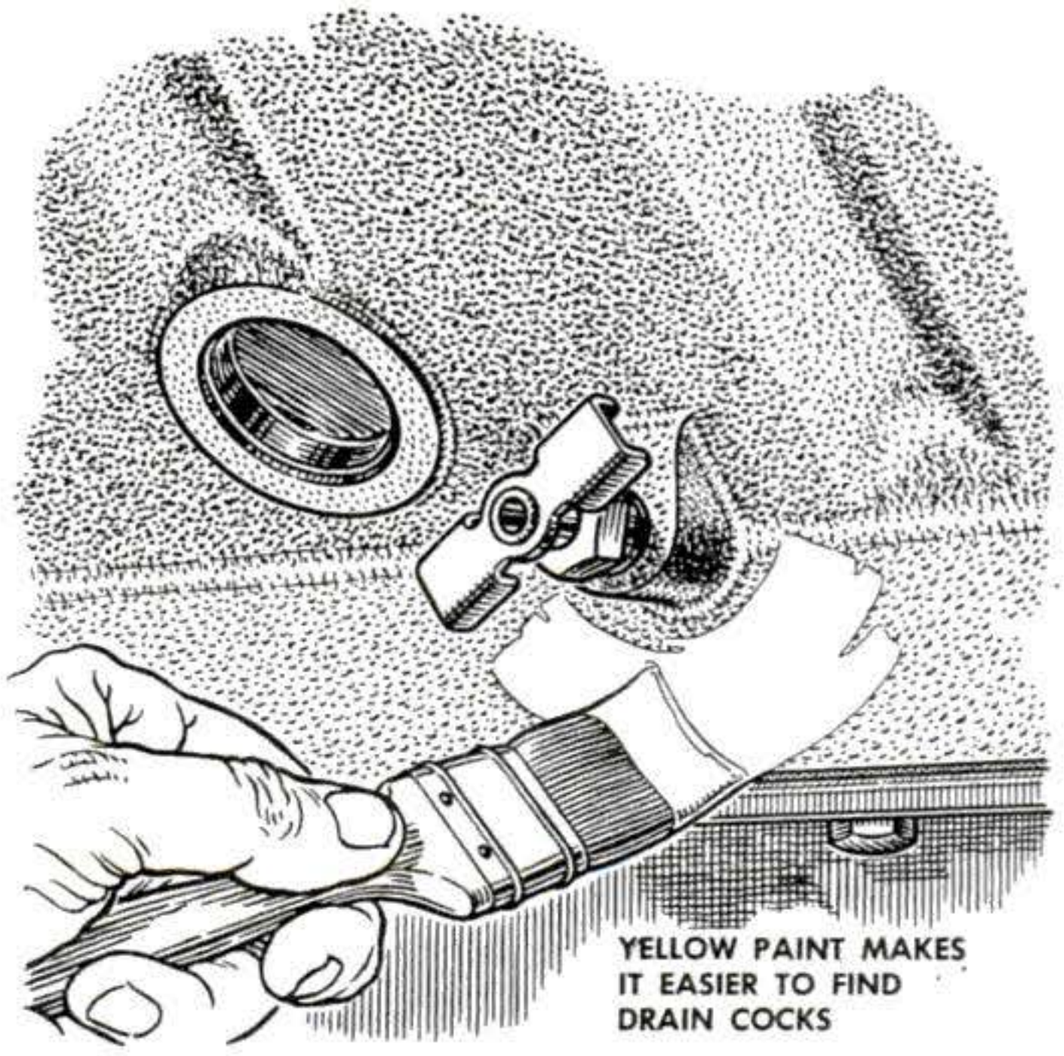
Radiator tips: When pouring antifreeze, use a funnel to keep the liquid from sloshing around on the cap rim and running out of the overflow tube. It's a good idea, too, to clean the pressure cap with detergent to keep it working freely.

Do You Have an Auto Hint? Send It In and Win a Prize

HAVE you discovered or developed a money-saving short cut for making your own auto repairs? Have you found an easier way to do a difficult job? Got a tip that will make driving safer or easier? Or do you know someone who has?

POPULAR SCIENCE will pay a cash prize of $15 for every auto-repair hint accepted for publication in "Hints from the Model Garage."

Describe your hint as completely as you can in words. Add a pencil drawing, or shoot a photo, if you feel this will make your idea more easily understood. Address your entry to Model Garage Editor, POPULAR SCIENCE, 355 Lexington Ave., New York 17, N. Y.



Drain cocks will be easier to find if you paint the handles and the area around them with bright yellow or white paint. When it's time to drain, just shine a light in their direction and they'll stand out brilliantly.

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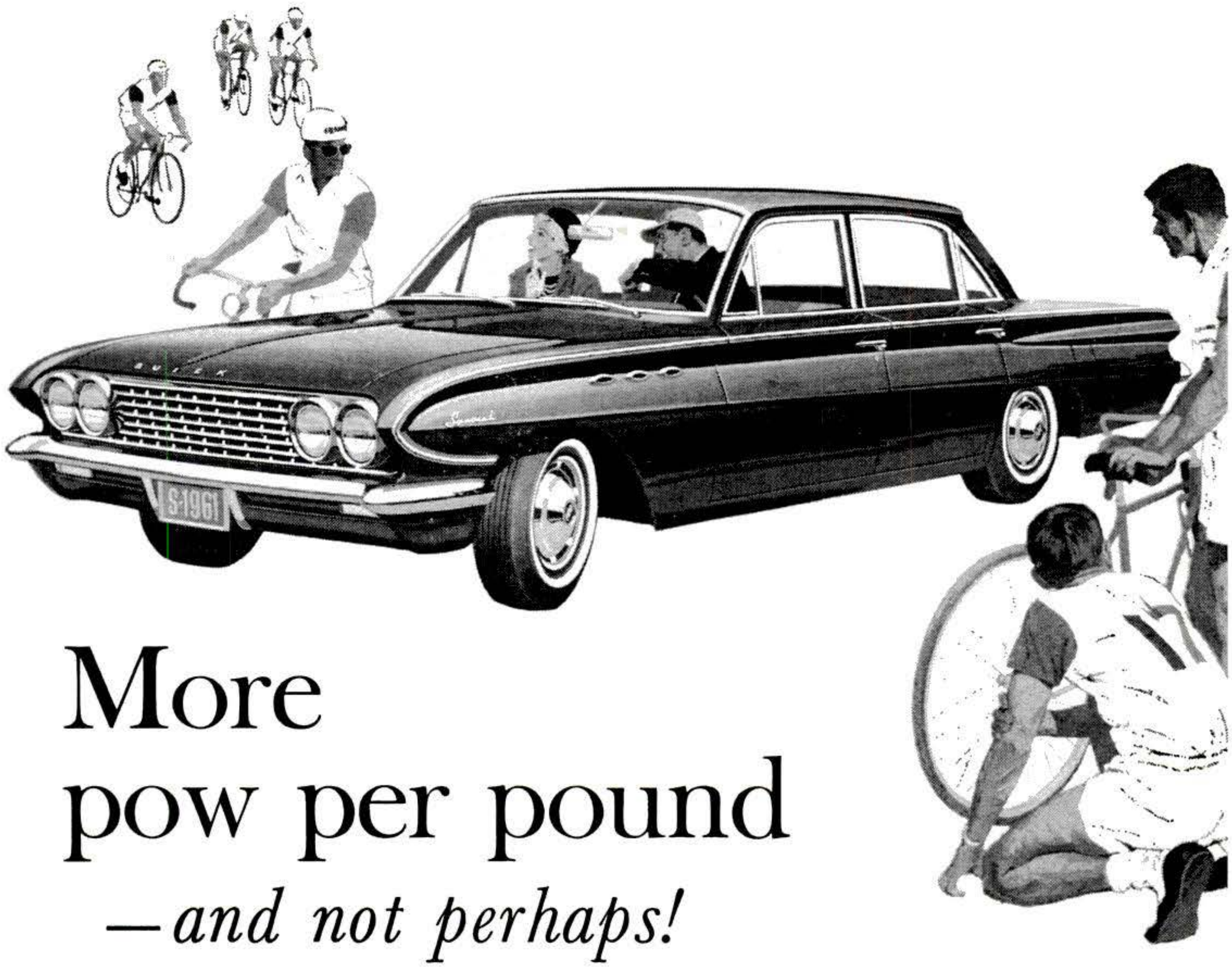
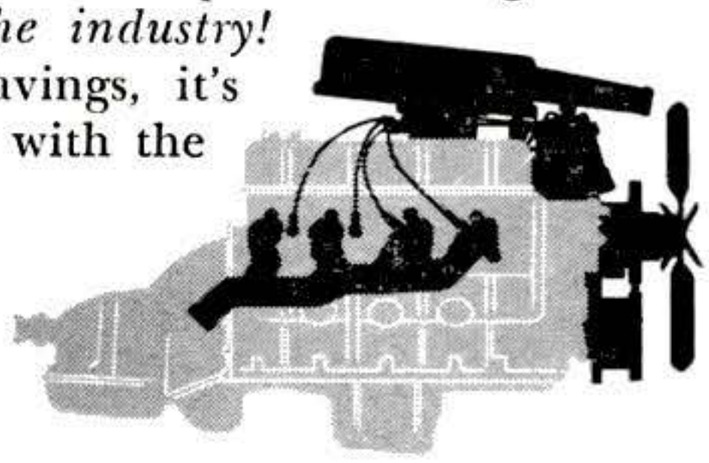


More pow per pound
—and not perhaps!

WHY IS THE BIGGEST NEWS in '61's new-size cars Buick's snappy Special? Styling for one. It's got the full-size Buick's Clean Look of action — and Buick room and ride. This on a 112" wheelbase—that nips in and out of tight spots like a scooter.

But the really big news in this beauty is its *oomph!* The Special has *twice* the pow per pound of most compacts . . . actually more than many full-size sixes and V-8's! The miracle explained?

BUICK'S REVOLUTIONARY ALUMINUM V-8. This hot 155 HP Fireball V-8 weighs just 318 pounds for a .487 horsepower to weight ratio *— highest in the industry!* Yet for gas savings, it's right up there with the compacts. Sports Cars Illustrated magazine has already predicted it will be "the most widely copied engine in the next 10 years."



BUT THERE'S EVEN MORE to the Special's zip. It's Buick's new Aluminum Dual-Path Turbine Drive* (weight: just 100 pounds)! Made just for a new-size car, it's the liveliest, simplest, most compact automatic made. Its "dual path" principle is like having two transmissions continuously working as a team—one a turbine drive for smoothness, the other a direct mechanical connection for more go and gas savings.

IN A NUTSHELL, the Special gives you small car pleasure without small car penalty. Why not take a Special spin today and prove it for yourself? Buick Motor Division—General Motors Corporation. **Optional at extra cost.*

BUICK SPECIAL

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Captain Bullock jerked his head toward Stan Hicks. "Since he worked on my car this afternoon, I've lost three speeders—engine skips if I go over 50."

Gus Puts a Spark in the Holiday Season

By Martin Bunn

"THERE goes a dreamboat," murmured Stan Hicks as the sleek convertible rolled out of the Model Garage.

"The car or girl?" asked Gus Wilson.

"The—that convertible, Boss. All it needed was plug cleaning and new points, but I put in a condenser, too."

"I know, Stan. It's all here on Betsy's bill—except one item."

"Uh—what's that, Gus?"

Gus grinned. "Tender, loving care."

Stan reddened. "Matter of fact, Gus, there *was* something not on the bill. I reconnected the rear-seat speaker with enough wire so it could be taken out of the car for our skating party. I'm going, too, so it was on the house."

"That's okay. Where will it be?"

"Burr Pond, from three o'clock till after dark. Skating, carol singing, and fireside eats. Think I can get away?"

"On a Saturday Christmas Eve? Sure think so, Stan. Should be a quiet day."

But Gus was wrong. Business picked up briskly after lunch. Gus had to go out

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on a turnpike call. Stan replaced a bad wheel bearing for a salesman racing home for the holiday.

THE phone rang just as the salesman left. With an anxious eye on the clock —it was 2:30—Stan answered.

"It's Gus," said the receiver. "Need a fuel pump for this car, and every place I've tried is either closed or out of that model—a WC12. Got one?"

Stan checked the stockroom, found a pump, and trudged sadly back to the phone. "Want me to bring it, Boss?"

The receiver chuckled. "Way up here to the interchange? No, Stan. You're saved—Trooper Jerry Corcoran spotted the stalled car. His relief is leaving the police barracks in 15 minutes. Get that pump there and go to your party."

"Sure will, Boss. Yes, sir!"

Walking on air, Stan entered the big granite State Police barracks. He was unprepared for the heavy hand that whirled him about.

"You're Gus Wilson's mechanic, aren't you?" demanded a truculent voice. "Been trying to raise you on the blower for 10

CONTINUED

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minutes! We have an emergency here!"

"Yes, sir. I know," faltered Stan. "Got the pump right here—"

"Pump? What pump? I've got ignition trouble. Every car that'll wheel is on the road for holiday traffic duty. My own won't. Your job—fix it!"

Belatedly Stan focused on gold bars. The voice came from a red-faced captain. Stan blurted out the tale of Gus's phone call and a trooper took the fuel pump from him.

ONE minute later, Stan was staring woefully at the V-8 in a patrol car.

"Our shop gets the holiday off," explained a gray-eyed trooper leaning over it. "This car of Captain Bullock's just won't start, and I'm not mechanic enough to find the trouble. Look."

Distributor cap off, the trooper held the high-tension cable from the coil near the block, snapped the points open. "Not a spark," he said. "But there's battery juice here. Watch."

Taking the primary wire off its terminal on the distributor, he sparked it against the block. "First I thought the points weren't opening far enough, but that's not the trouble."

"Let's see," said Stan. With the ignition still on, he flicked the primary wire against its own terminal. It sparked again. Stan held the points open, again touched the wire to its terminal. Again it sparked.

"Passes juice with the points open," he pointed out. "That means the condenser's shorted. Got any spares in the shop?"

A drawer labeled "ignition parts" held only a pair of points.

"Might cobble up a fix with that suppressor condenser off the generator," suggested Stan in desperation, "if you don't mind radio interference."

"*I* mind!" roared the captain, entering in time to hear. "This is police work, young fellow. Get a condenser!"

Wheeling back to the Model Garage, Stan prayed he wouldn't find still another customer. He got the condenser, tore back to the barracks, installed it, was thanked with a grunt, and watched Captain Bullock roar off as if to a bank robbery. It was now 3:30.

"How's it going?"

LATER in the evening a spruced-up Gus drove past Burr Pond on his way home from a standing date—Christmas Eve supper at the Parkinson farm. The bonfires were out, but two cars remained, snowflakes swirling around them. Automatically Gus slowed as he saw that one car had its hood up and the other was a police car.

Stopping a short distance away, he could make out a girl in the convertible, its windows shut against the cold. Outside, a slim young man faced a burly, loud-voiced, apparently angry trooper. As Gus dimmed his lights, the officer came over.

"What do you—oh, Gus Wilson, is it? You're just in time."

"For what, Captain Bullock?"

"To make good on what your mechanic did to my car." The officer jerked his head toward the young man. "Since he put a new condenser in this afternoon, I've lost three speeders—engine skips if I go over 50. Coming by here, I spotted this stalled car. It's him—seems now he can't get his own car started."

"Glad I happened along," said Gus. "Let me talk to Stan a moment."

With a grunt, the officer strode off. Stan's face, as he came up to the Model Garageman, was a blend of embarrassment and relief.

CONTINUED

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"Sure glad it's you, Boss," sighed Stan.

"Tell me about the captain's car," Gus said. "Maybe we can think it out."

Stan told of his trip to the barracks, of the trooper who had tried to start the dead engine. "He thought it was the point setting, but it was easy to spot a shorted condenser."

"But if he *thought* it was the gap," mused Gus, "maybe he reset it too wide. That'll make a high-speed miss. Here—I've got an ignition kit. Take it and check the gap. I'll wait."

MINUTES later, the police car roared into action and sped away. Stan came over to Gus, grinning wryly.

"You got it, Gus. Points were way out. Should have checked this afternoon."

"Maybe you and the captain were both in a hurry," said Gus. "Now what about Betsy's car?"

Stan's grin faded fast. "It's a tough one, Gus. I know it has new points properly set, a new condenser, a good coil. So—no spark!"

"Did the radio run down the battery too far to start in this cold?"

Stan shook his head. "Starter's got plenty of pep. Gus, I've just got to get it running. Betsy's family is waiting to celebrate Christmas Eve—she wants to introduce me to them tonight. Some introduction, if I can't get her home in her own car without engine trouble!"

"I think I dig," said Gus. "Did it run all right getting here?"

"Guess so. I don't know. She was going to pick me up, but that police job made me late. I got a ride out."

"New points. A hot battery. Stan, did she have that radio working with the ignition on, any time?"

"Yeah! How'd you know? She didn't realize there's an accessory position. I switched the key over soon as I saw."

Gus grinned. "Take the stone in that ignition kit and dress the points."

"But they're brand new!"

"Ever hear of blued points, Stan? In this cold, circuits have low electrical resistance. With the ignition on, a heavy current went through those points—enough to heat them and form a blue oxide coating that blocks current."

"Gus," said Stan in awe, "if you're right, I'll wash your car free."

Hustling back, he busied himself on the convertible. Soon the starter whirred and was promptly followed by the roar of a willing engine. Stan scurried back with the ignition kit.

"I—uh—didn't tell her it was you, Boss. Just said I had to borrow some tools. Okay with you?"

"Sure is, Stan. Good luck."

"Free car wash, Boss. And thanks!"

The convertible skimmed away. Gus started his own engine, but just as he was about to pull out, a swelling siren froze his throttle foot. The police car braked hard, neck and neck with his own.

"Seems he's done it this time!" roared Captain Bullock.

"Done what?" asked Gus.

"Fixed it. Runs great now. Guess I was a bit hasty with the boy."

Gus smiled with relief. "He'll understand, Captain."

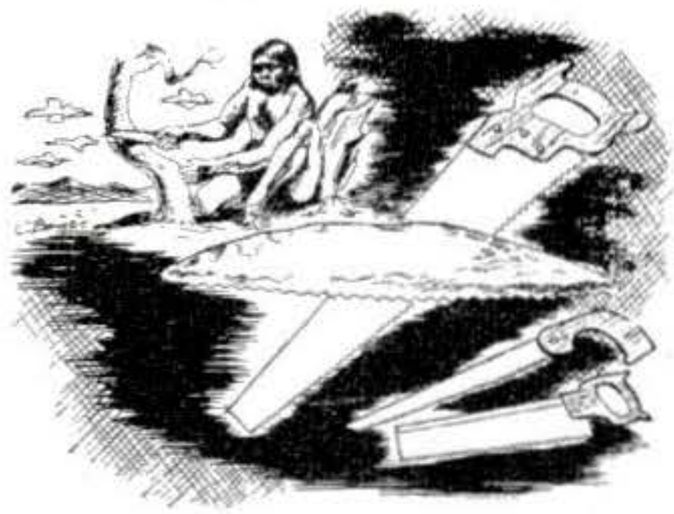
"Well, I'll go easier on him next time. As for you, Gus Wilson, I've got just two words to say to you."

"I'm listening."

The captain grinned like Saint Nick himself.

"Merry Christmas!" he roared.

Where'd it come from?



THE SAW: The earliest saws were of flint and had serrated teeth. Some have been found on Old Stone Age sites in southern France, (dating back 100,000 years). Flint saws were still in use in the Bronze Age (about 3000 to 1200 B.C.). But the flint saw had the disadvantage of any stone cutting tool: Its edge couldn't be tapered finely enough and so wedged into the groove it was cutting. The thin-bladed copper saw was a vast improvement, and by 1900 B.C. Egyptian copper saws were even being made with the familiar pistol-grip handles. However these still had notched teeth. The technique we use today of raking the teeth all in one direction did not appear in Europe until the Iron Age (beginning about 1200 B.C.).

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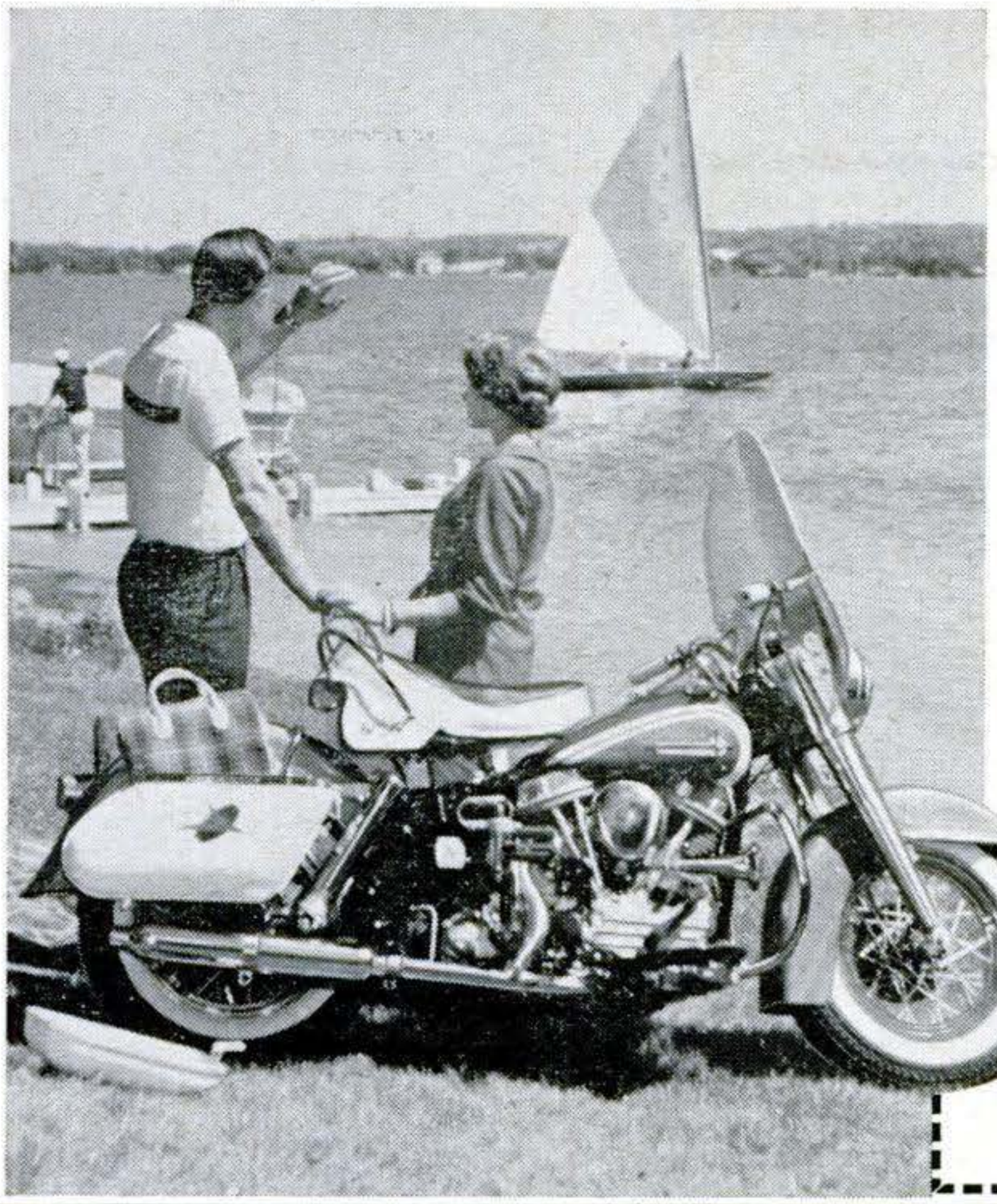

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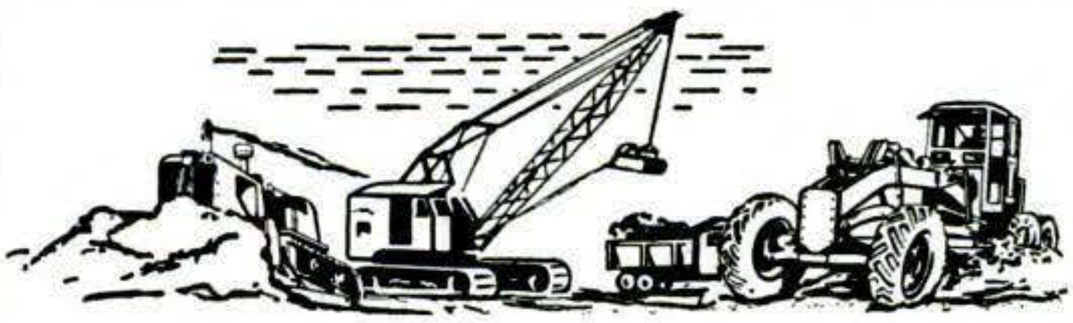

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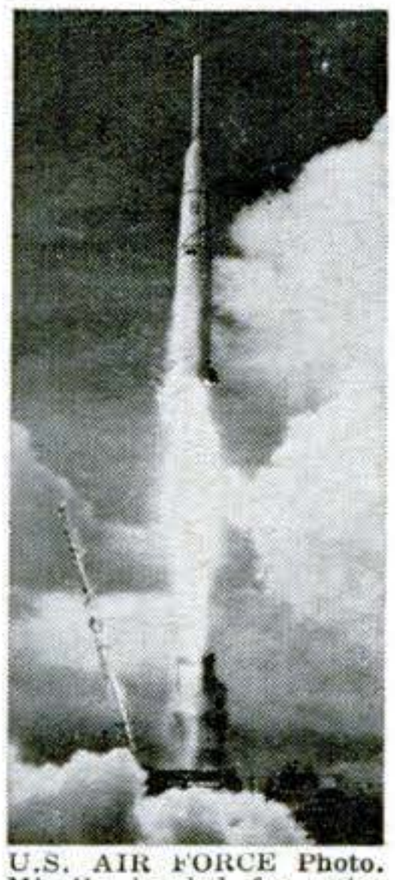

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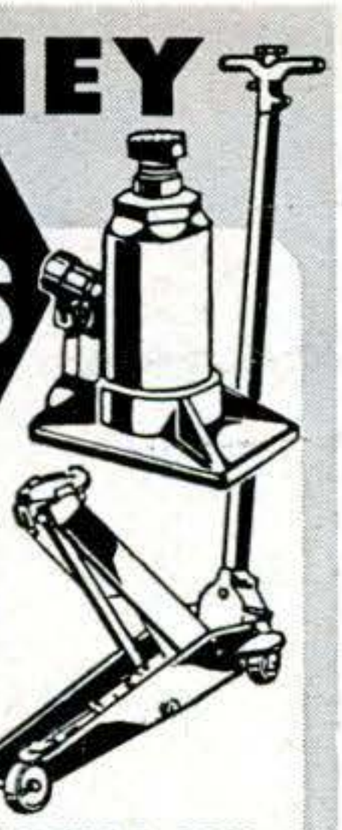

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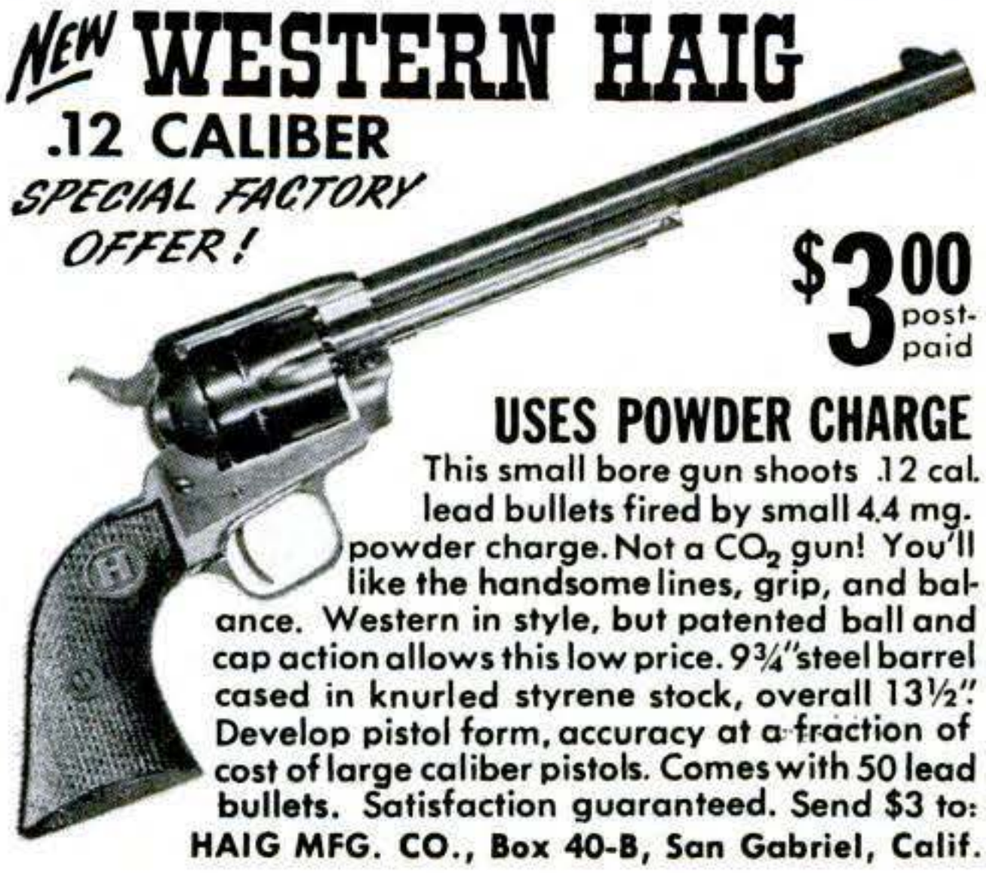

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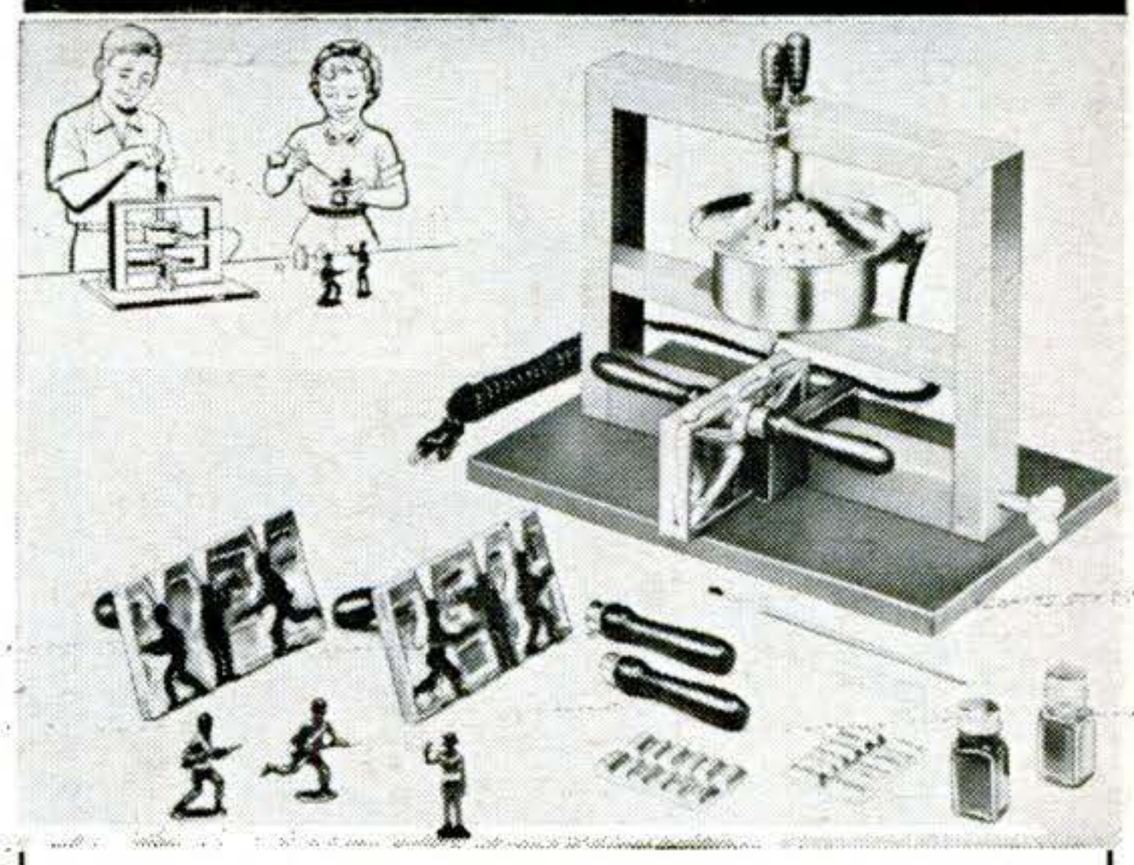

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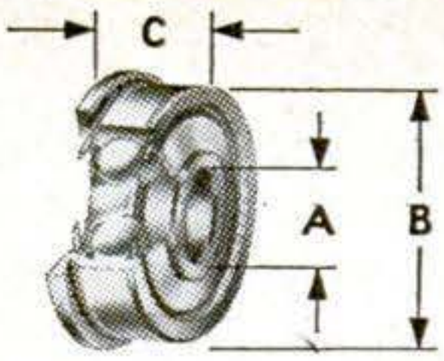

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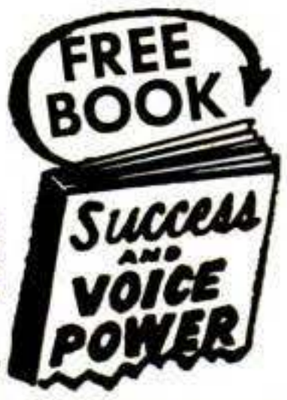

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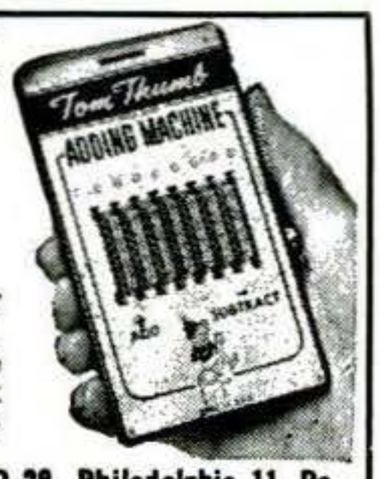

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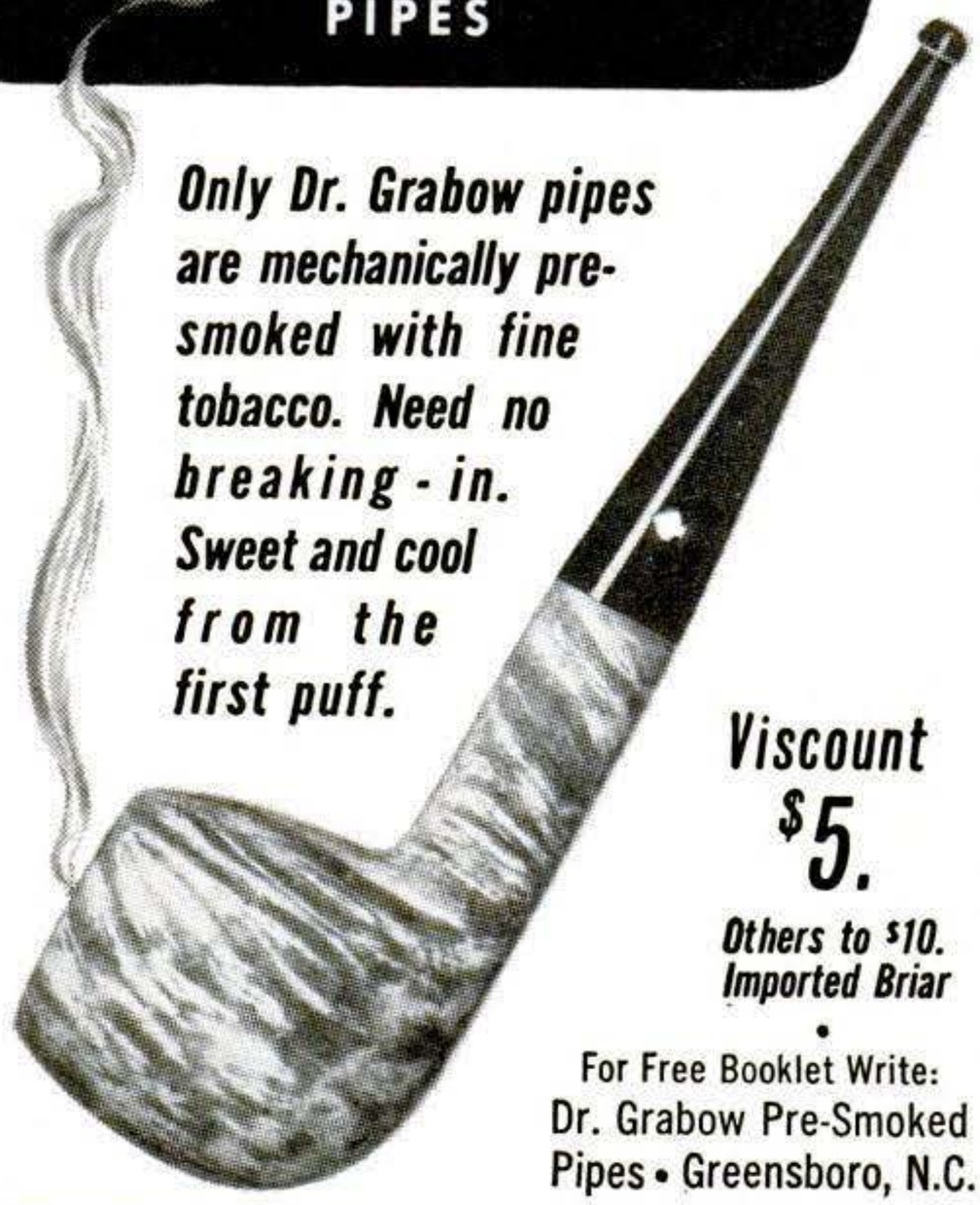

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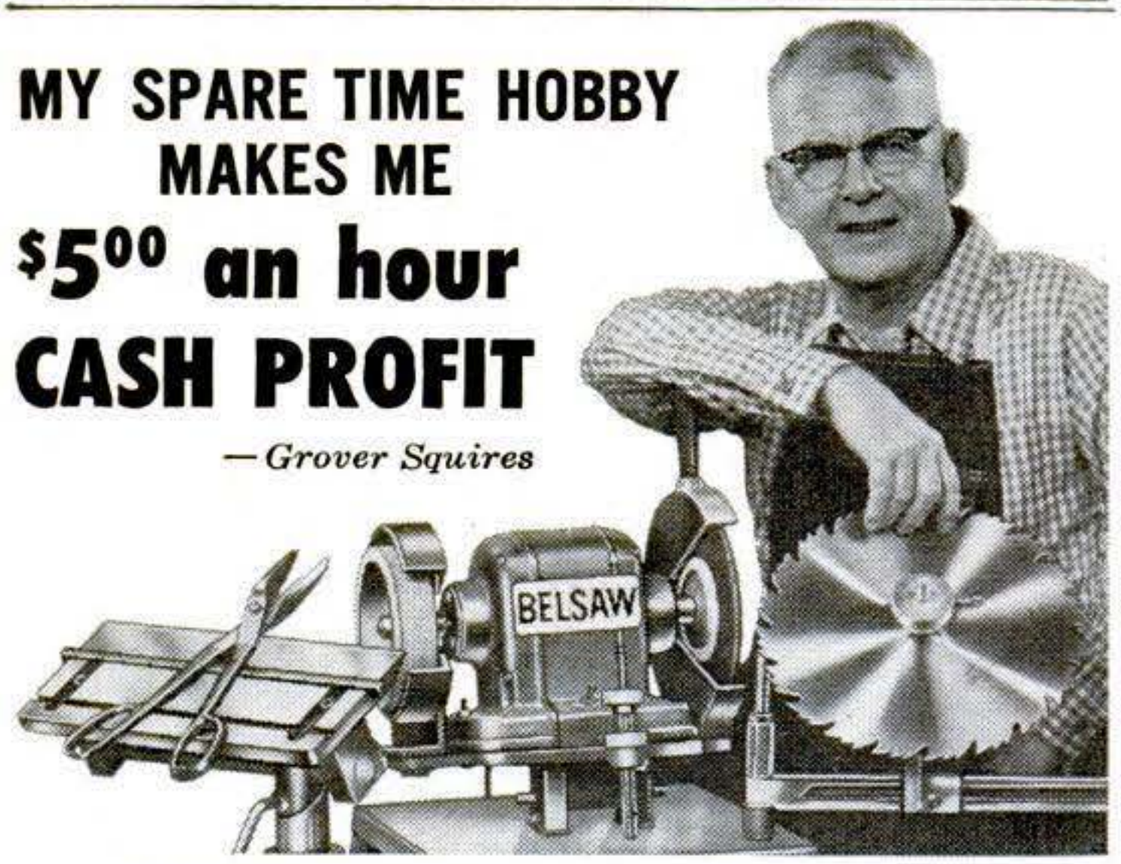

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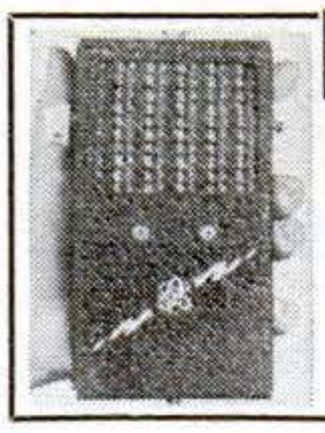

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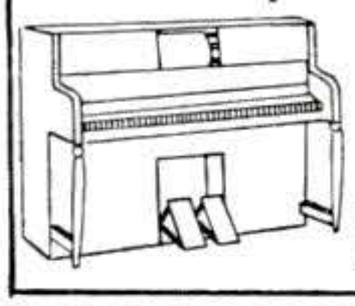

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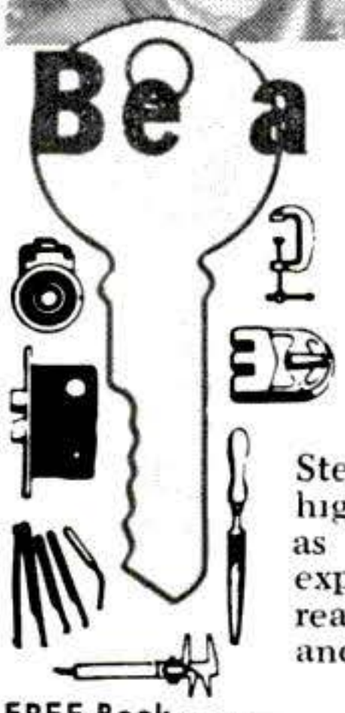

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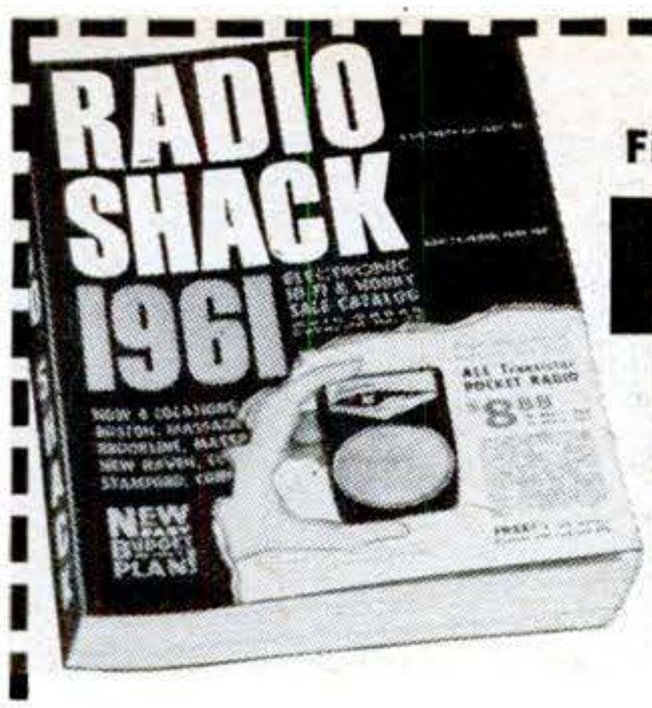

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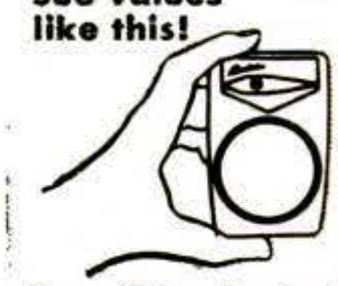

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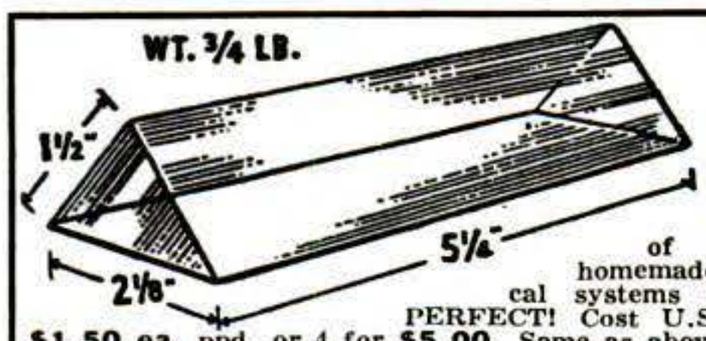

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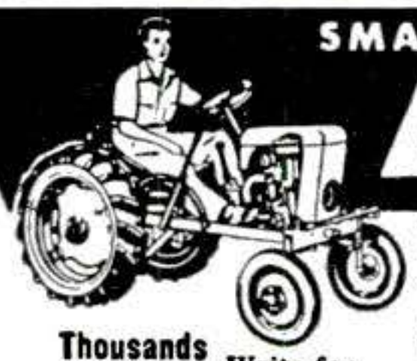

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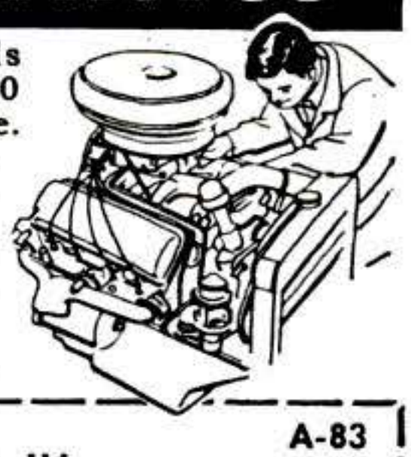

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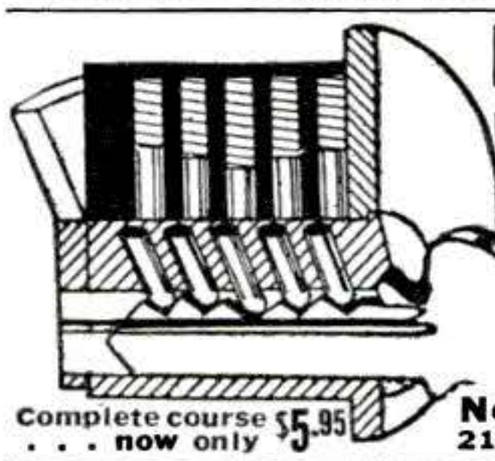

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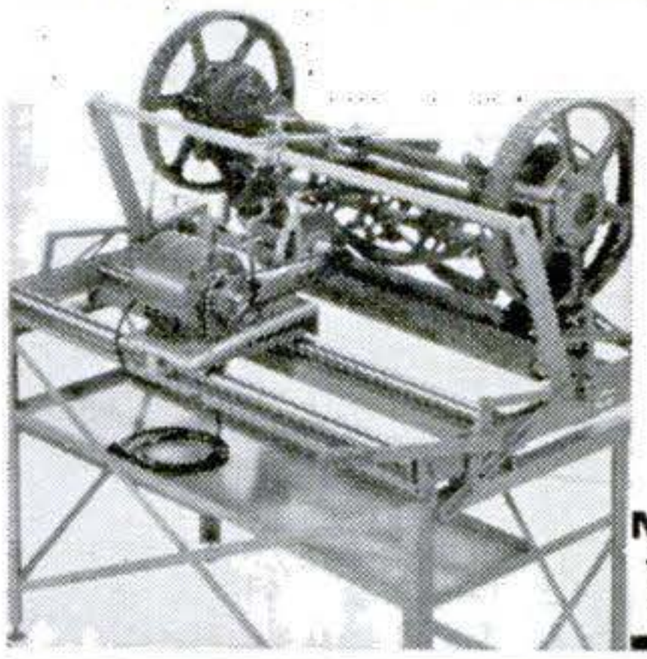

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Not everyone does as well, but T. N. CODY, who started a business of his own, reports . . .

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DETROIT REPORT

By Ken Fermoyle *PS Detroit Editor*

Aluminum Sixes? Mum's the Word

CHRYSLER isn't saying much about it, but one of every ten 1961 slant-six engines will have a die-cast aluminum block. They look like, and have the same specifications as, those cast from gray iron. But they're more than 100 pounds lighter.

The blocks use cast-iron cylinder liners. Heads and manifolds are also made of iron—for now. Ultimately, engineers hope to pare costs so that head castings can be aluminum, too. Their intricate interior passages make that too complex and expensive for the moment.

Manufacturing capacity and minor production problems are all that hold the aluminum blocks to the present 1-in-10 ratio. By next year, all slant-six engines are likely to have them.

Meanwhile, Chrysler reports, you can specify the aluminum block if you like. And at no extra charge. If you don't, you still might get that tenth engine by chance.

No valve-gear change on Fords. The tricky, spring-loaded cam arrangement, designed to maintain zero lash in the valve train of 1961 six-cylinder engines, fell by the wayside at the last minute. Persistent bugs kept cropping up and Ford decided to hold it back rather than run the risk of customer complaints.

It's far from dead, however. An engineering task force keeps busy experimenting with cam designs and different spring tensions to make the system foolproof. Big incentive: It could eliminate expensive hydraulic lifters while doing away with the bother of adjustable mechanical tappets (which Ford continues to use for all sixes and some V-8s).

Answers could come in time to let Ford make a running change during the '61 model year. If not, it looks like a sure bet for 1962.

New headliner adds to headroom. Other car makers are interested in the snap-in, one-piece, laminated-fiber-glass acoustical ceiling American Motors introduced across the board in its '61 models—and not just because of its sound-absorbing qualities, which are excellent.

The material clings tightly to the contour of a car ceiling, more so than conventional "cut-and-sew" headliners. This can add up to another ¾ inch of headroom.

Conventional liners take expensive time and labor to install. The molded fiber-glass costs more at the moment, but its easy snap-in installation repays some of that cost. And insiders expect greater production to cut costs still more. Look for more of them in 1962.

Flats at all-time low. Flat tires cause fewer breakdowns today than ever, reports the American Automobile Association. Significantly, says AAA, tire failure has declined steadily since 1955—the year when tubeless tires became standard equipment on almost all of the new cars.

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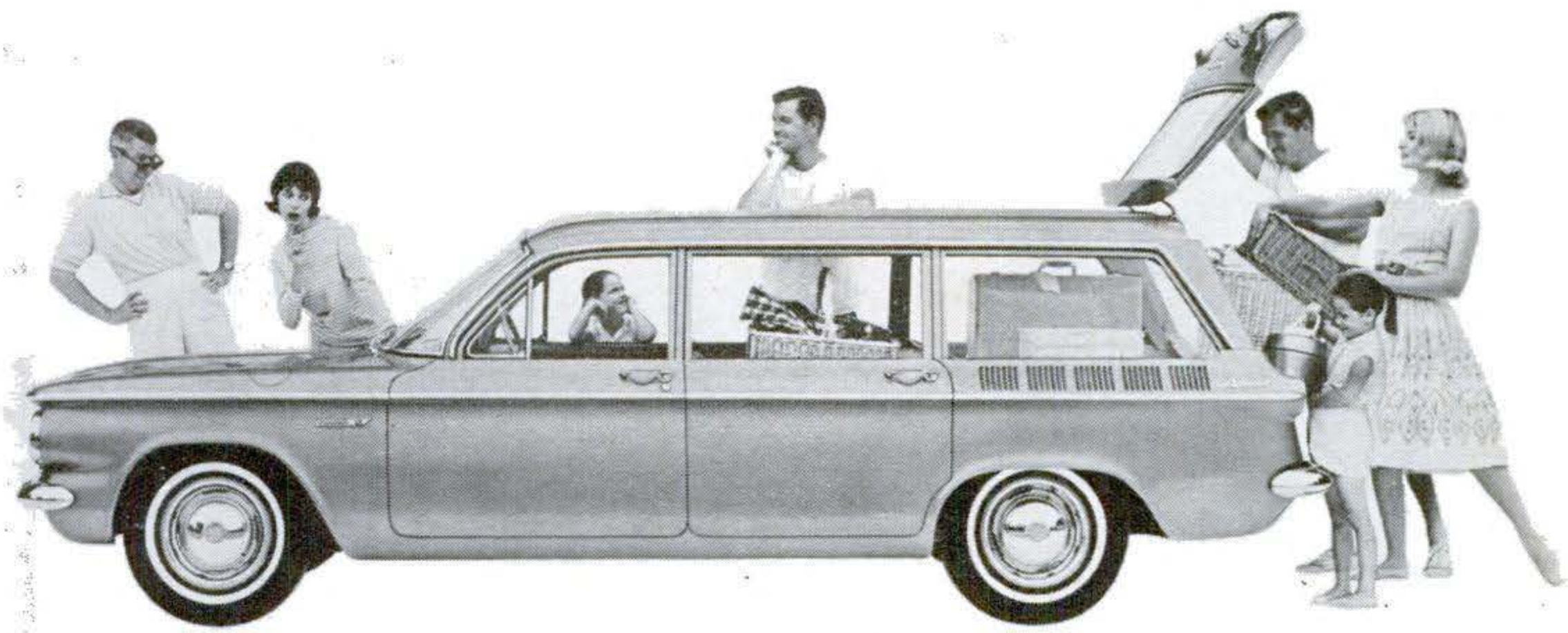
This Corvair 700 4-Door Sedan has provisions for heating ducts built right into its Body by Fisher.

more spunk, savings and travel space!

More happy ideas from the new '61 CHEVY CORVAIR!

Wasn't easy, but we managed to make Corvair even more desirable in '61: we boosted the displacement of that air-cooled rear engine to 145 cubic inches. Made Corvair even thriftier to run: Coupes and Sedans carry lower prices, and quicker cold-start warmup gets you saving fast. (There's a new heater* that distributes heat more evenly, and a longer range fuel tank.) Added space inside for you, up front for your luggage. (Sedans and Coupes give you nearly 12% more space under the hood.) You'll like Corvair's smarter styling, too, the minute you see it. But that's not the half of Corvair's good news for '61. Now Corvair has family-lovin' wagons for you! Interested? Read on!

Chevrolet Division of General Motors, Detroit 2, Michigan/ *optional at extra cost.



The Lakewood 700 Station Wagon—4 doors and up to 68 cubic feet of cargo area.

Coming your way—the nimble Greenbrier Sports Wagon.

The Lakewood Station Wagon does a man-sized job with cargo, yet handles like a charm. Our Greenbrier Sports Wagon—unlike anything ever built in America before—has space for up to 175.5 cubic feet of people and things on a maneuverable 95″ wheelbase. Check that against the wagons you're used to. Same rear-engine traction, same parkability that have become a Corvair trademark. See the whole sensible lineup soon—at your Chevrolet dealer's.

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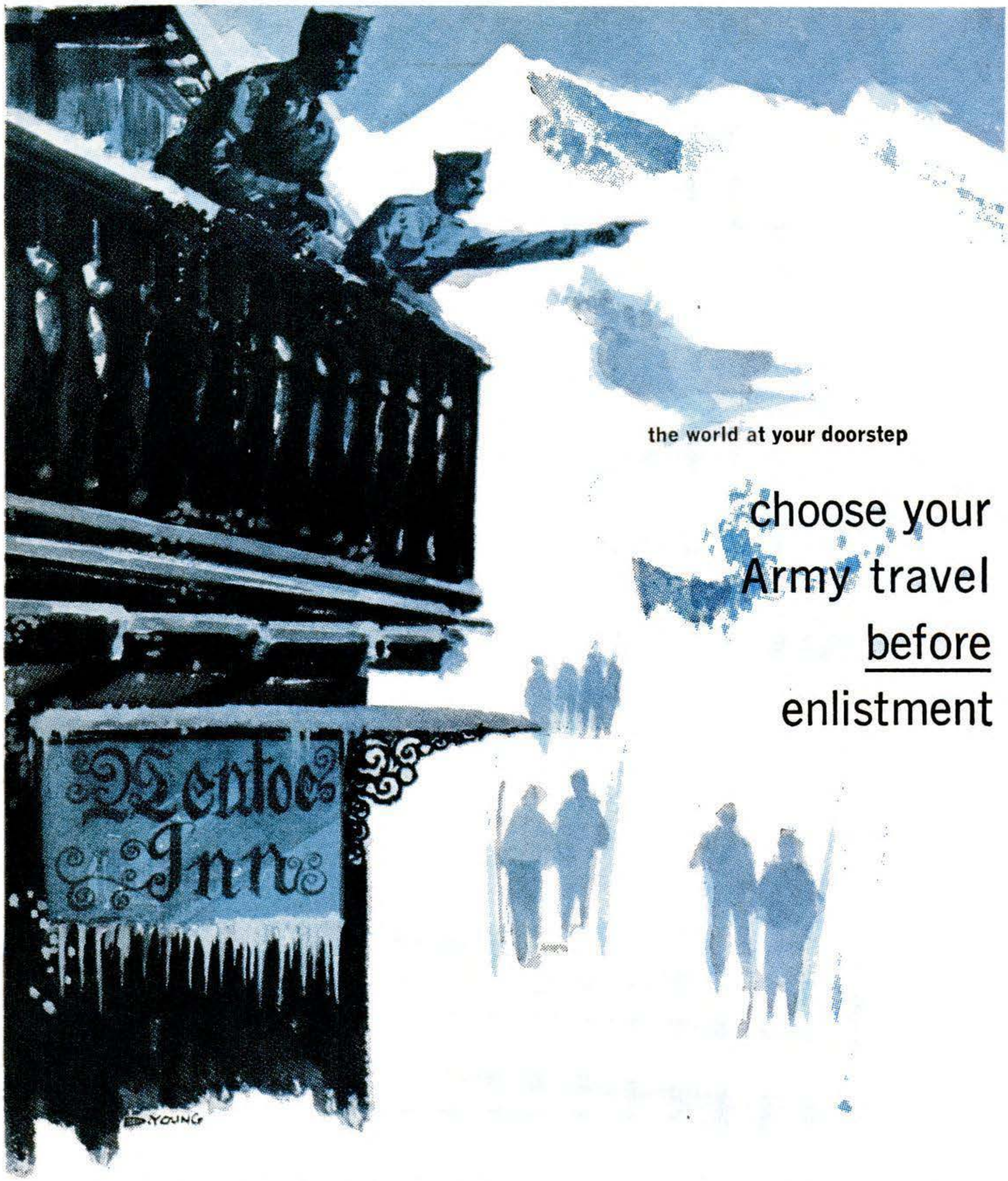

Like skiing? How about the Bavarian Alps? Swimming? Try the beautiful blue Mediterranean. Mountain climbing? Tackle the heights of Mt. Fujiyama in Japan. Today's Army lets you **choose** the oversea area where you'll be stationed—Europe or Far East. On duty and on leave, you'll be able to travel widely while you're there. Ask anyone who's traveled. Nothing beats the excitement of new and fascinating places. And now the Army puts them at your doorstep. So don't just dream of faraway places you'd like to see. Make your travel arrangements with your Army recruiter this week. See him—and choose your travel before you enlist!

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POPULAR SCIENCE
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You can foil the light-fingered fraternity if you know—

How Pickpockets Pick Pockets

By M. Robert Beasley

THE next time you go to the races, or a fair, or even a public picnic, and you hear someone call, "Watch out for pickpockets!" don't feel for your wallet. There's a chance that the man who gave the warning is himself a pickpocket. Feeling for your wallet is exactly what he wants you to do—for now he knows which of your pockets to pick.

The professional pickpocket is deft. He is proud

CONTINUED

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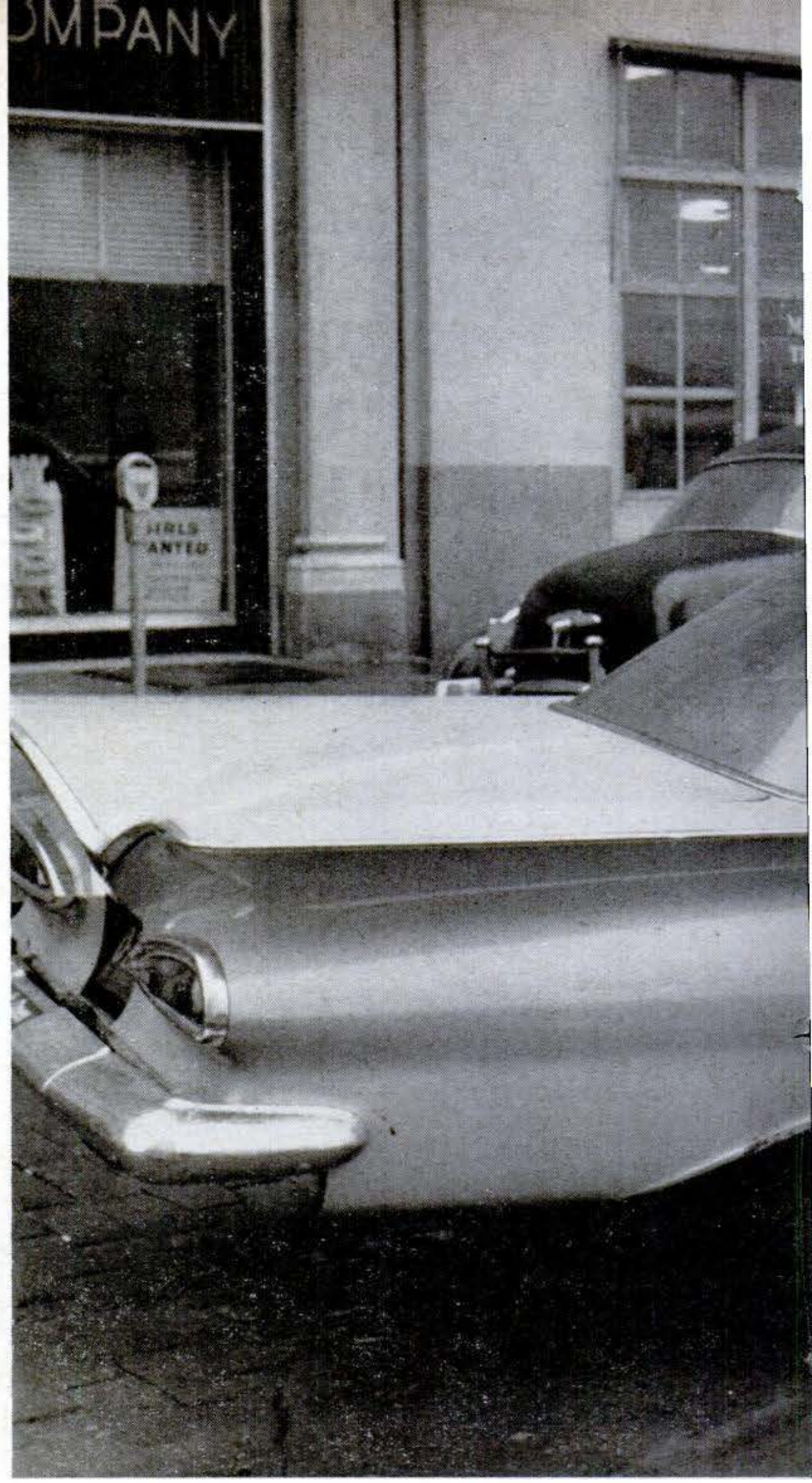
Study this picture... someone is stealing $8,000

The men at the right are enacting the climactic moment of one of the most daring routines of organized crime. A wholly unsuspecting citizen is being deftly, efficiently relieved of the $8,000 he's just withdrawn from the bank.

Can you tell the sheep from the wolves? Study the scene and see if you can figure out what's happening—and how. Then turn the page for the answer.



of his skill. He is nervy. But what impressed the author most, during many personal interviews with convicted criminals behind the walls of the world's largest prison at Jackson, Mich., was the typical pickpocket's knowledge of human reactions in any given situation—what he calls his "grift sense."

He knows that if you, a normal individual, are jostled, you will react with surprise and apology, or with irritation. He likes that—anybody momentarily upset is less likely to feel those lightning-fast, practiced fingers in his pocket.

He knows, too, that you may suspiciously clap your hand to your wallet pocket. That's fine. He knows now where you keep your money.

The pickpocket knows that a woman shopping is likely to be careless about where she puts down her purse. Her first reaction to its loss is incredulity and bewilderment. That's good. In those fleeting moments he makes his getaway.

Pickpockets are organization men

No branch of petty crime is better organized than pocket-picking. The professional rarely works alone. He will have at least one other man on his team, possibly as many as four or five if he works a "troupe."

Pickpocket's Jargon

Cannon: Any member of a pickpocket team
Fan: Light fingering to locate wallet
Grift sense: A knowledge of human reaction
Hanger binger: A specialist in emptying women's shoulder purses
Hustle: Method of operation
Impression: Wallet located
Jug troupe: Team specializing on marks leaving banks
Leather: A wallet
Mark: Victim
Moll busser: A thief who preys on women
Pit worker: A wire who can lift leather from an inside pocket
Score: A successful pocket-picking
Stall: A wire's partner
Stiff: A hand-concealing item; a newspaper
Wire: The specialist who lifts your wallet

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The thief who does the actual job of lifting the wallet, is called the "wire." He has a partner, the "stall," who spots a promising victim, the "mark," and initiates the action. The stall may set the mark up for the wire by jostling, or even by an innocent exclamation at a standup lunch counter: "Look out, you're spilling your coffee!" A good actor, the stall can be counted on to improvise a fitting diversionary action.

A troupe is probably the best-trained team of men in the pickpocket trade. Theirs is a precision operation with a sharp division of labor. One team member merely picks the mark. Two or three others divert his attention. The wire steps in like a matador, the star of the show, only for the kill.

The pickpocket caste system

The light finger comes in various grades. Low man on the totem pole among pilferers is the fellow who works department or grocery stores, plucking coin purses from the pocketbooks of women whose backs are turned. On a bad day, he is not above "boosting"—shoplifting—in the stores to make a dishonest penny.

Only a cut above the purse-lifter is the pickpocket who reaches into a woman's shoulder bag to extract money. In

CONTINUED

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his grubby little corner of the underworld he is known as a "hanger-binger."

The wire who can "fan" a mark—feel where the money is—and, with the aid of a stall, separate his victim from a wallet in the rear pocket has more dignity among his fellows. The operation takes skill. To perfect himself, it's entirely possible that he has practiced—with each hand—for weeks on a dummy fitted out with trip switches. The slightest clumsiness flashes a light. That's devastating to a pickpocket. He's a vain man.

"Tell me how I got caught," many an incredulous pickpocket has asked an arresting cop.

How they do it

The classical "score," as obtaining money by levitation is called, is a simple, but precise, operation. Let's assume you are the mark. You're wedged in among standees in a bus at the rush hour. Your wallet is in your left rear trouser pocket. A man behind you, the wire of the pickpocket team, has his arm raised in front of him, ostensibly to ward off the body collisions caused by stop-and-go. Under his other arm he carries a folded newspaper—his "stiff."

His raised arm presses on you. You're used to this in jammed buses. But just to be sure, your left hand comes back to feel your wallet. The wire is grateful. You're cooperating.

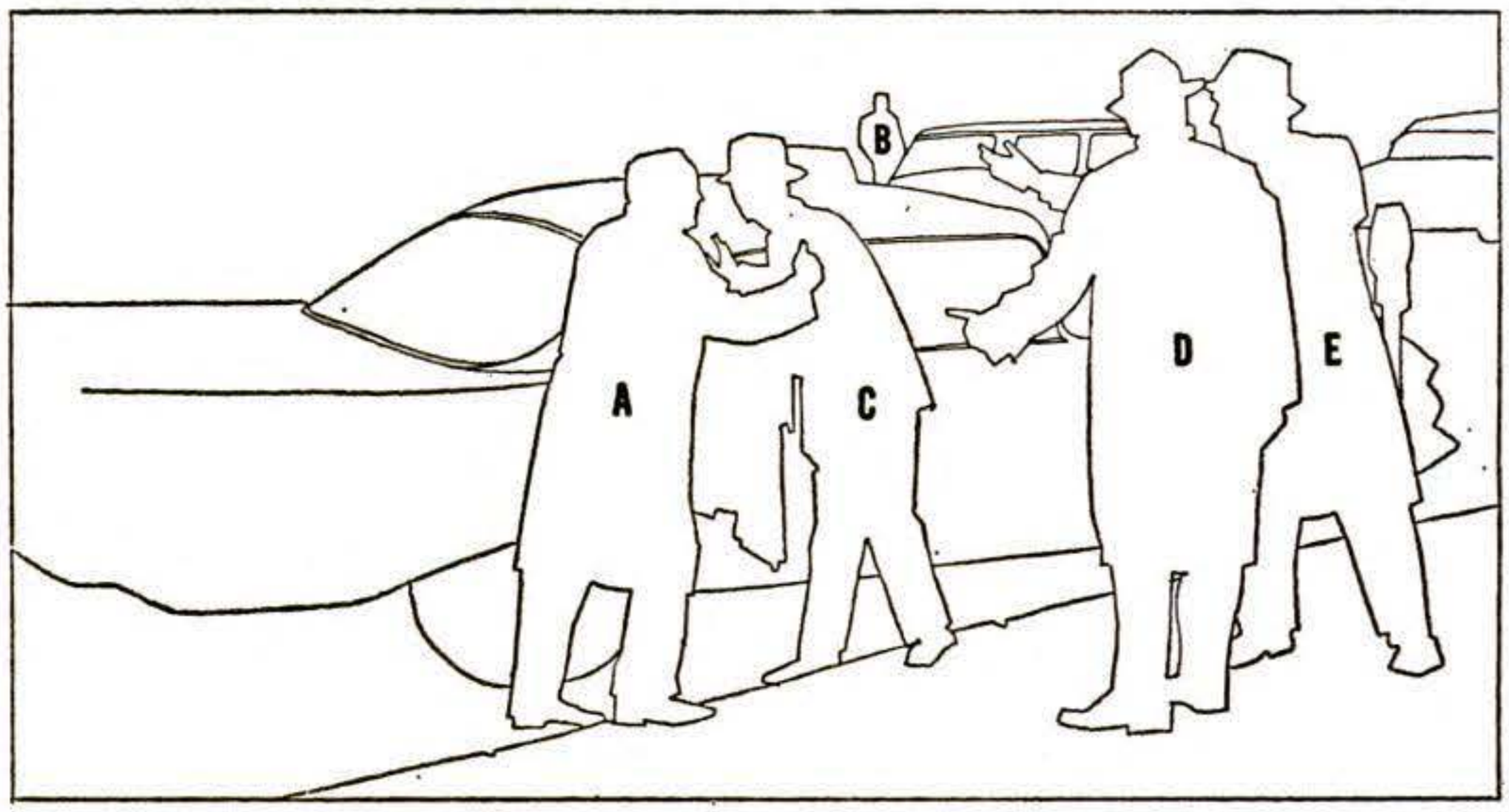
Getting out of an elevator

That's right, look behind you because someone carelessly bumped you. That's all the time the pickpocket needs to lift your wallet and tuck it quickly into a fold of his trench coat.

But just to be sure, himself, he conducts a delicate, two-second fanning of that pocket, maintaining his diverting arm pressure for a cover. Now he has his "impression"—the location of your money.

By eye, he signals his stall, who stands facing you. The stall lurches. You collide with him. The stall glares. How could you be so rude? In the confusion, the lurching and the pressing together of bodies, your wallet is transferred gently and unobtrusively to the folds of the newspaper. If the wire and stall have timed it right, they are out of the bus at

Here's a "jug troupe" in action



Shown on the previous page is a tricky example of criminal teamwork. The victim is A. Everyone else in the picture (except the cab driver) is a crook. When A was in the bank, B spotted him withdrawing a tidy sum. He followed him out, then used a handkerchief to key his teammates to the pocket where the wallet would be found.

As A hailed a cab and started to get in, D came up and claimed it was his cab. E agreed. A, diverted and confused by the arguments, was an easy mark for C who stepped in, picked A's pocket as he passed, and is about to make his getaway—adding insult to injury—in the very cab that A had hailed.

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In the movies

Gentleman that you are, of course you rise to let the lady pass. But her boy friend in the row behind you is passing, too—your wallet into his pocket. Then he's out and away.

On a bus or a subway

"What's the idea?" you ask the passenger who shoved you. But that was the accomplice's cover for the pickpocket—behind you. Your wallet is now secure in the folds of his newspaper.

the next stop before you've recovered from confusion.

You won't feel for your wallet again for another minute or two.

Pit workers don't mine coal

But that can't happen to you. You are smart enough to carry your wallet in the inside pocket of your jacket. Well, just how smart are you?

The recognized king of the pocket-picking art is the "pit worker." He's the fellow—with the aid of a stall, to be sure—who can reach into that inside jacket pocket and withdraw your wallet without detection.

Let's say you're coming out of an elevator. A man approaches you rapidly on a collision course. Over his arm he carries a topcoat. He raises his arm at the moment that you almost walk into each other. At the same time a man behind you does actually jostle you. That's natural—you've just stopped suddenly. There are gentlemanly apologies all around.

A block away, your inside jacket pocket feels empty. A search confirms it. Yup, the man behind you as you came out of the elevator was the stall, the man with the coat over his arm the wire. The upraised coat covered the pocket-picking operation.

The pickpocket fraternity reports that there are precious few really proficient pit workers left these days. The old ones die off, and the newer generations lack the gumption and application it takes to learn the business.

Then there are the jug troupes

If the pit worker is king of his trade, the "jug troupes" probably excite the greatest admiration among pickpockets as masters of the cooperative effort. They specialize in the transfer of money that is fresh from the paying-receiving window. A "jug," you see, is a bank.

Suppose you have just cashed a check. While the teller was wetting his finger and carefully counting the greenbacks, a respectable, well-dressed man nearby was watching with admiration. You're a splendid mark. You're loaded.

When you leave the bank, he follows. As you reach the street, he touches a handkerchief to his brow. Then he puts the handkerchief in one of his pockets—the pocket where you have your money. That's the troupe's cue.

If the troupe is at its theatrical best, it doesn't matter what you do from now on. Barring the intervention of Providence, you've had it. Let's say you hail a cab. Another member of the troupe, one of the stalls, grabs your arm as you reach for the door handle.

"What're you doing?" he demands. "I signaled for this cab!"

One or more other stalls joins in the argument. You are surprised at first,

[Continued on page 222]

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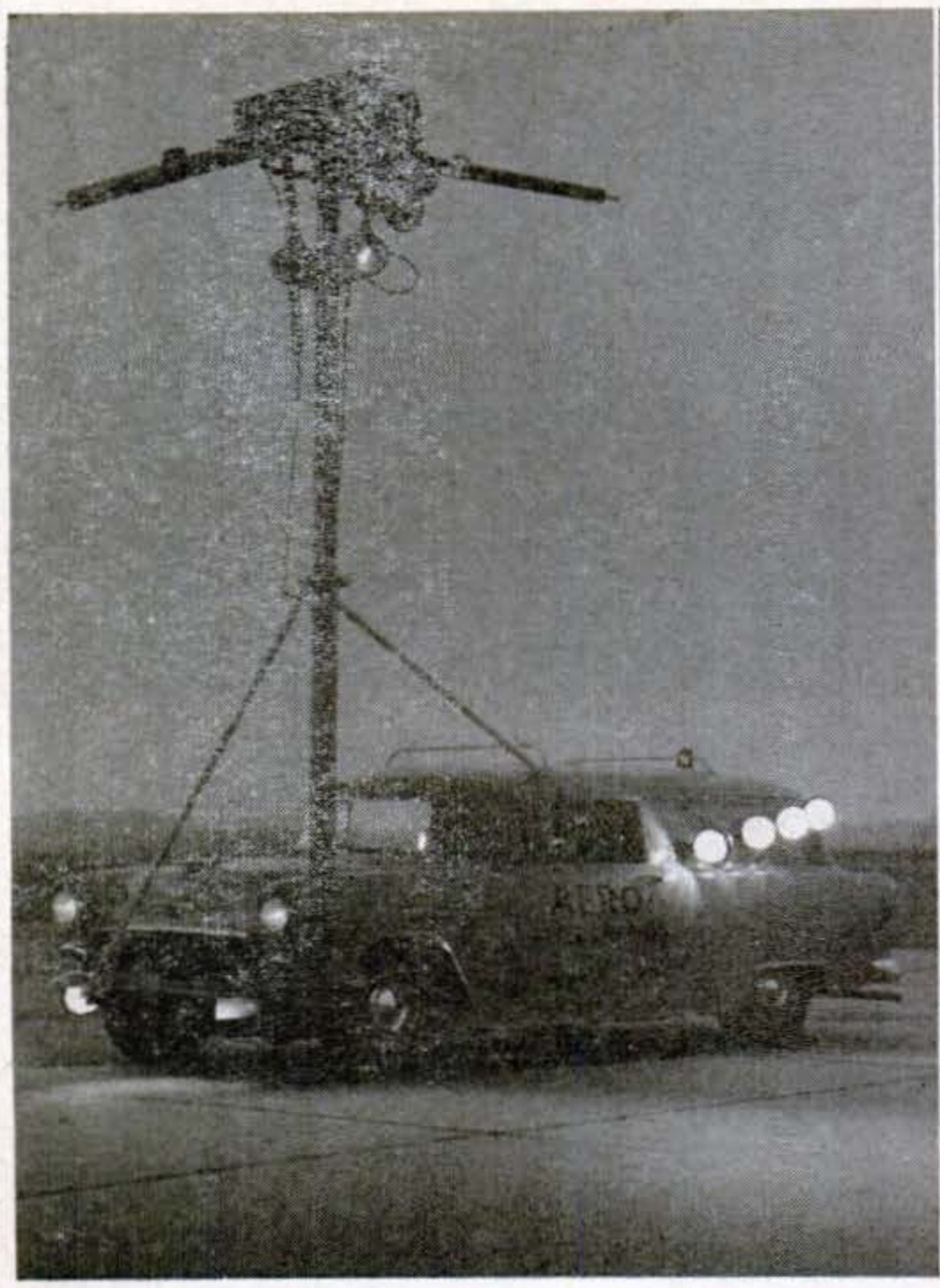
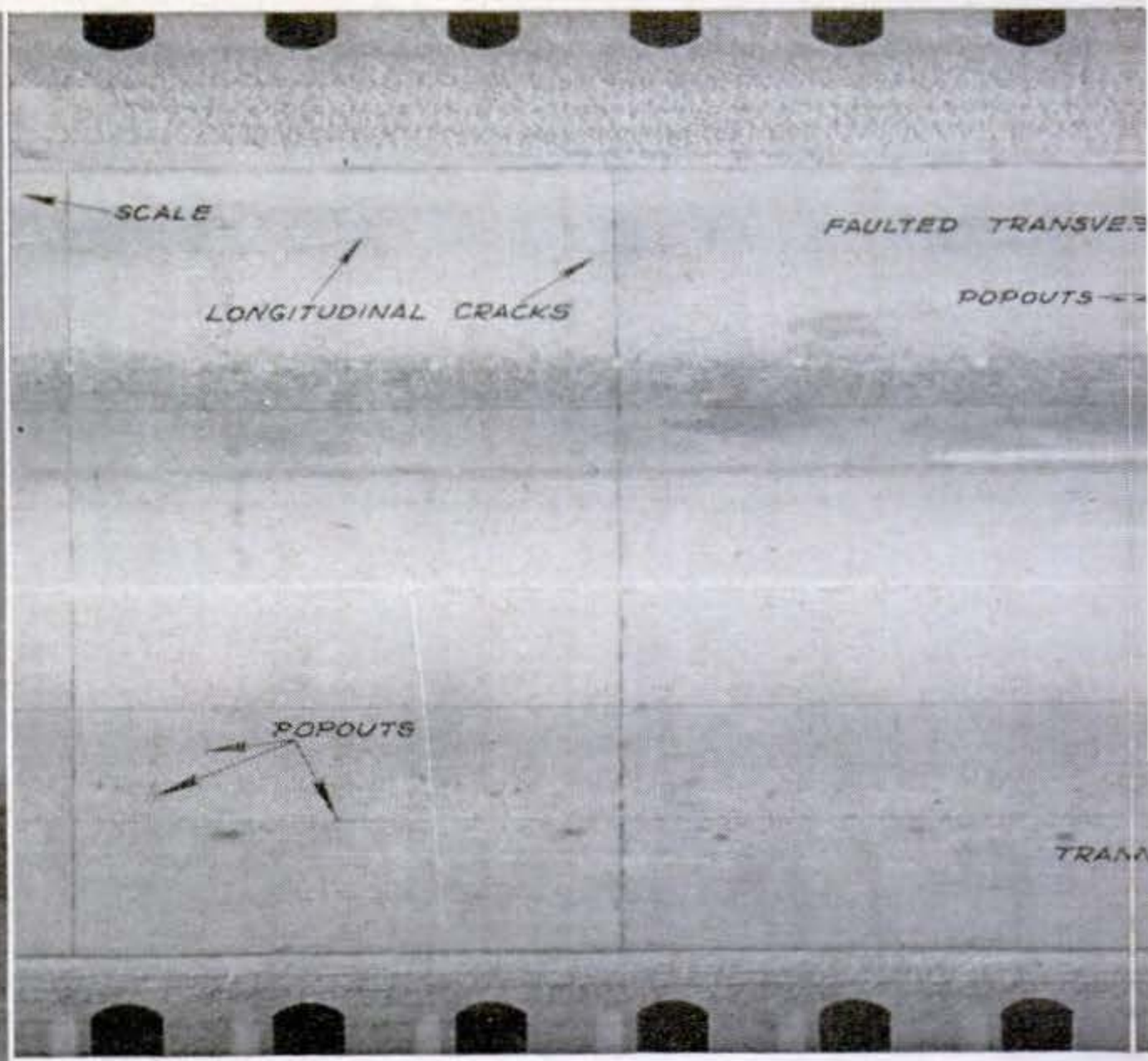


FAST, ECONOMICAL SURVEYS of road conditions are made possible by camera on tall, shock-free mount. Marks on highway or code numbers on film show where each portion of film was taken.



Film-strip photo, enlarged to a scale of one

Camera records road wear

Scale, faulting, spalling (crumbling), and other types of road wear are recorded

Goggles for GIs

Combat troops have long had body armor to protect the torso, and helmets to reduce head injuries. Now shatterproof goggles are being tested under battle conditions at Hunter Liggett Military Reservation in California. The Army calls them "transparent eye armor."

U. S. puts Russia in shade

These plastic parasols were made in the United States to shelter displays at the American Exhibition in Moscow last year. Now that the show has ended, they have been moved to Yalta, where the canny Russians have re-erected them to shade people at a popular seaside promenade.

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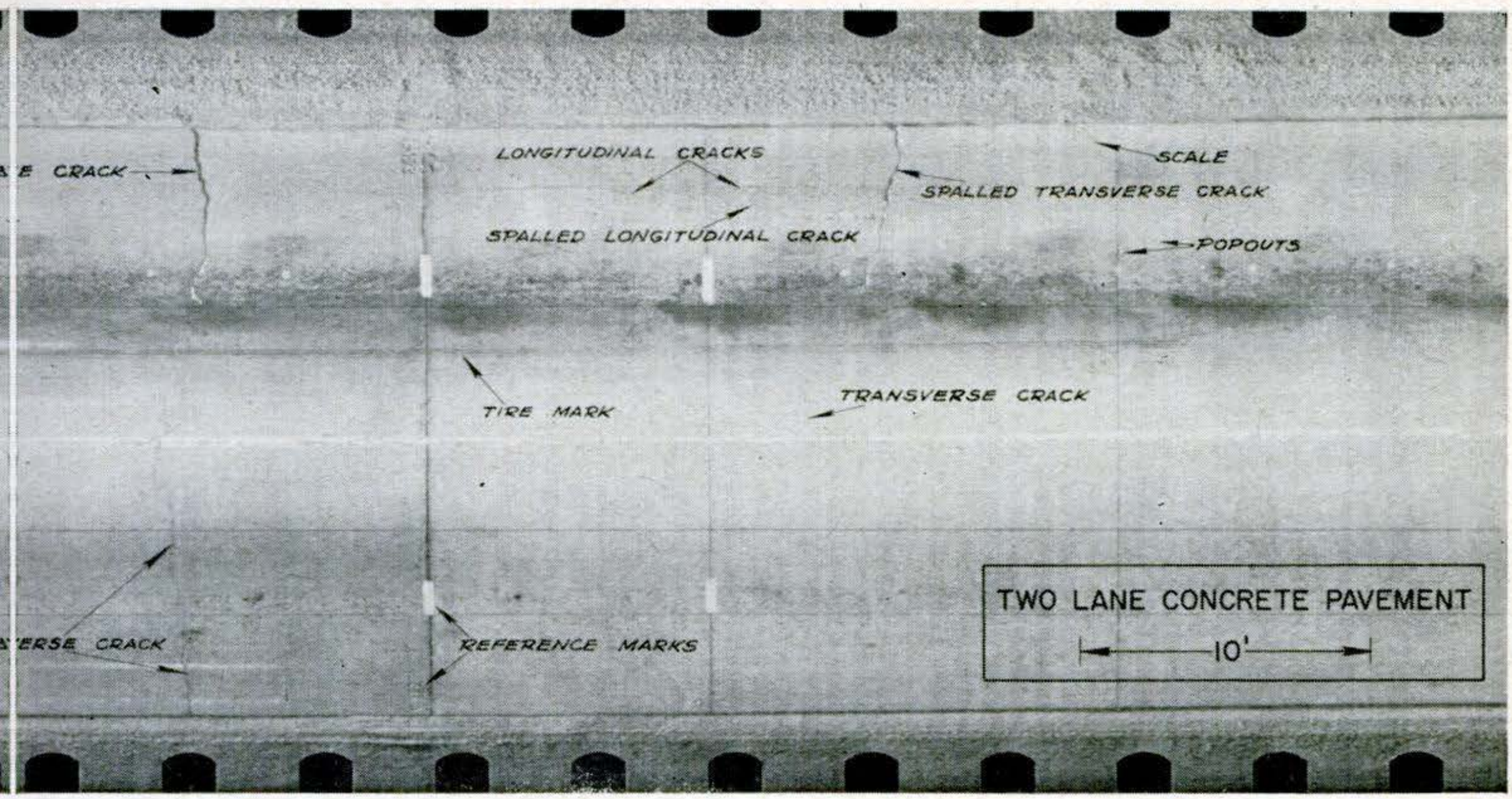
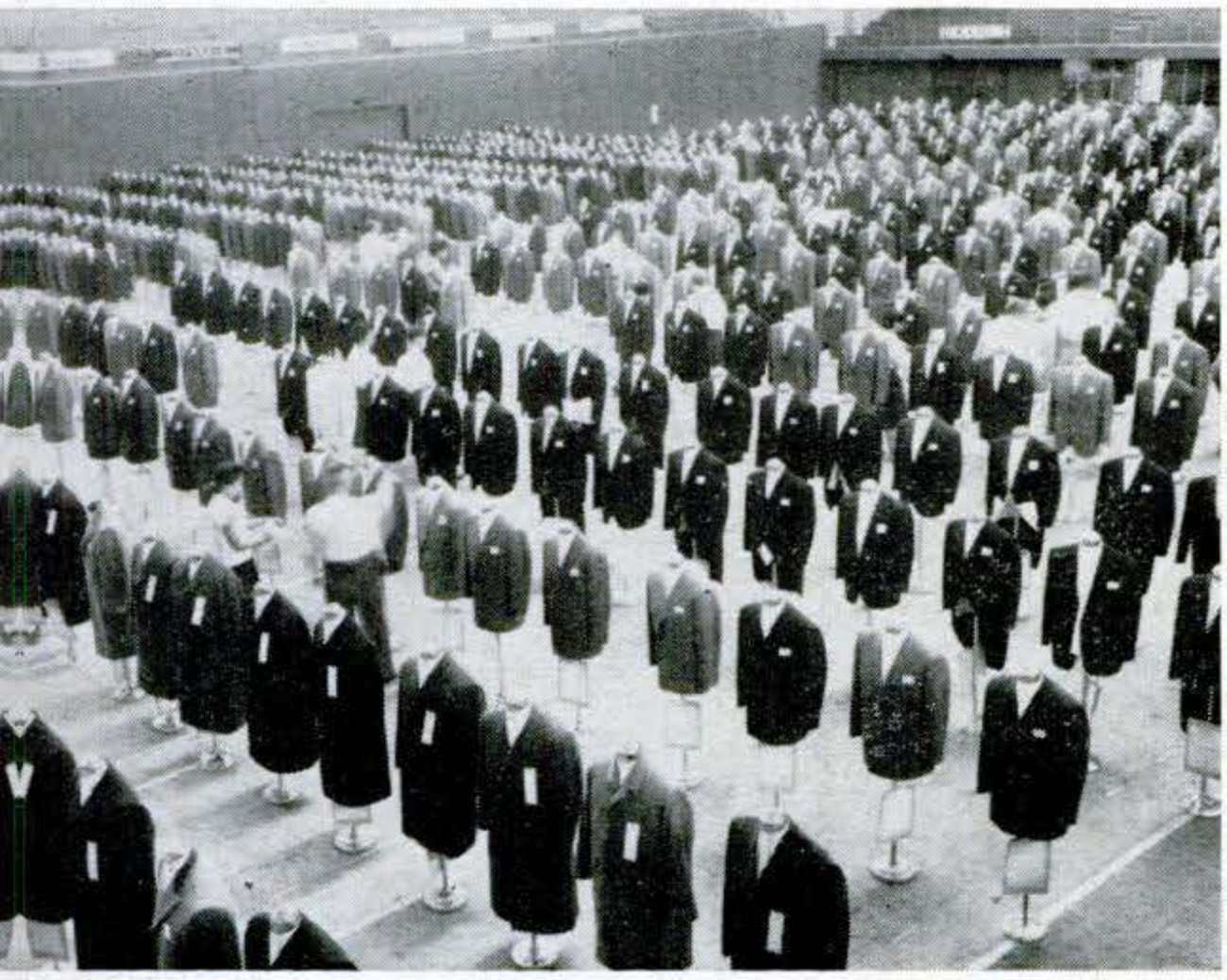


inch to nine feet, shows stretch of road. Film is projected or printed for study by road experts.

by the truck at left with a 35-mm. strip camera. The truck travels at night, to avoid heavy traffic and uneven daylight. It takes pictures by light of its own floods, which are powered by a generator in the rear. Roads as wide as 36 feet can be photographed in a single pass. The system, Sur/Fax, was introduced by Aero Service Corp., Philadelphia. It provides a permanent record of road conditions.



Array of dummies

These clothing dummies, standing at attention like a headless army, are submitting their apparel to inspection by a team of judges. They wear the latest in men's fashions made by Japan's best tailors. Judging is held in a Tokyo gymnasium to select "Japanese Tailor No. 1."

Do-it-yourself dry cleaning

Coin-operated dry cleaners have been introduced in laundromats in 20 cities throughout the country, as well as on a Midwestern university campus. Made by RCA Whirlpool, they clean an eight-pound load for about $1.50, up to $6 cheaper than conventional dry cleaning.

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Inside Story on the New 23-Inch TVs

Is the change in screen size a sales gimmick or an improvement? Even makers can't agree

By Martin Mann

TV MAKERS have sprung a new size on you. The 23-inch set, introduced tentatively last year, is sweeping the old standard 21-incher right out of the nation's living rooms. It costs more than the 21. Is it any better?

You'll find people in the business saying no, the new size is nothing but a twist designed to make your present set seem old hat. "Just like fins on an automobile," said one. But others spiel imposing advantages. Here is the inside story, a delightfully intricate tale of tricky engineering, million-dollar guesses, and corporation rivalries.

The new size—23 inches—sounds as if it's bigger than the 21. Is it? Well, yes and no. You do not get a *bigger* image. You do get *more* image: Parts of the picture that are clipped off by the 21-inch screen's rounded corners are included in the 23's nearly rectangular shape. This means that Bat Masterson's cane won't look any larger, but you might see more of its length.

TV screens are measured corner-to-corner, so squaring the shape makes the nominal size bigger without making the image bigger. The picture area added to the corners is 20 square inches, an increase of about seven percent.

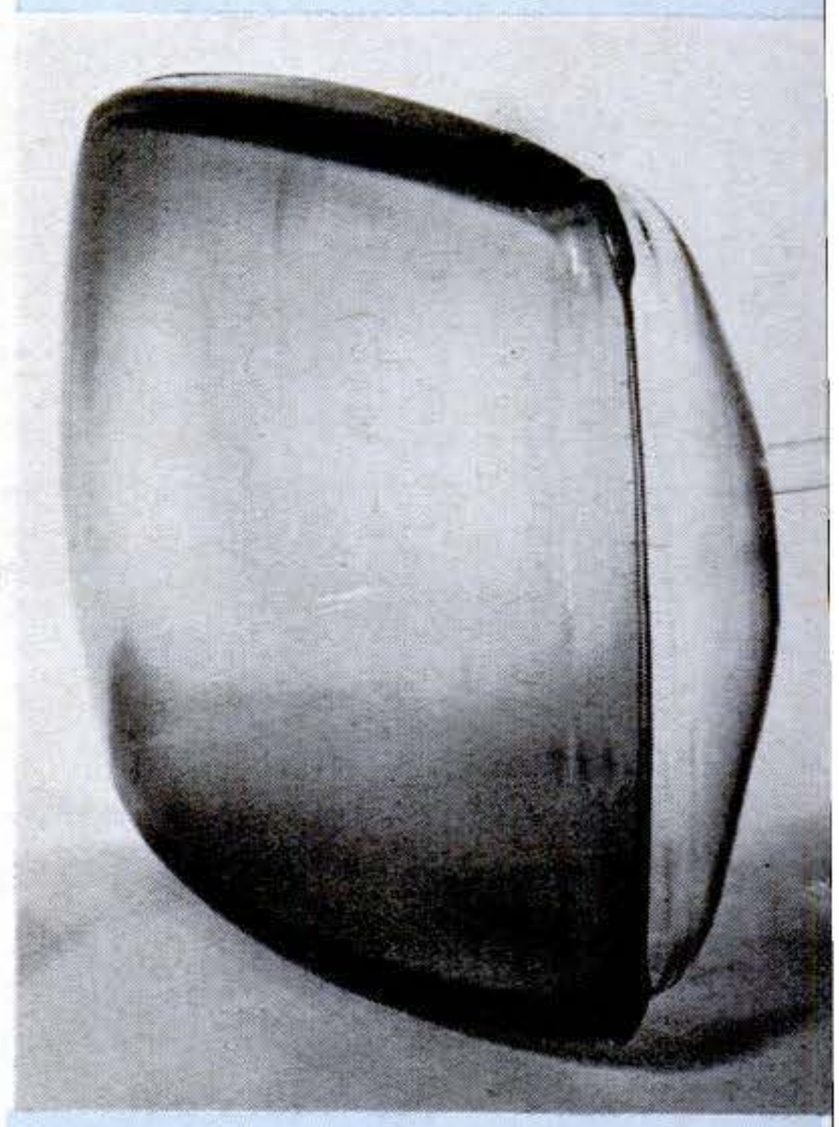
Numbers alone, however, don't tell the whole story. The 23-inch screen looks much bigger than the 21-incher. And it looks better, too. Most people, accustomed to the rectangular shape in movie screens, paintings, and photographs, prefer it for TV screens as well.

Not one, but two. The size advantages, physical or psychological, apply to all 23-inchers. Other things don't. There are two different 23-inch picture tubes (and also two versions of their companion 19-inch size).

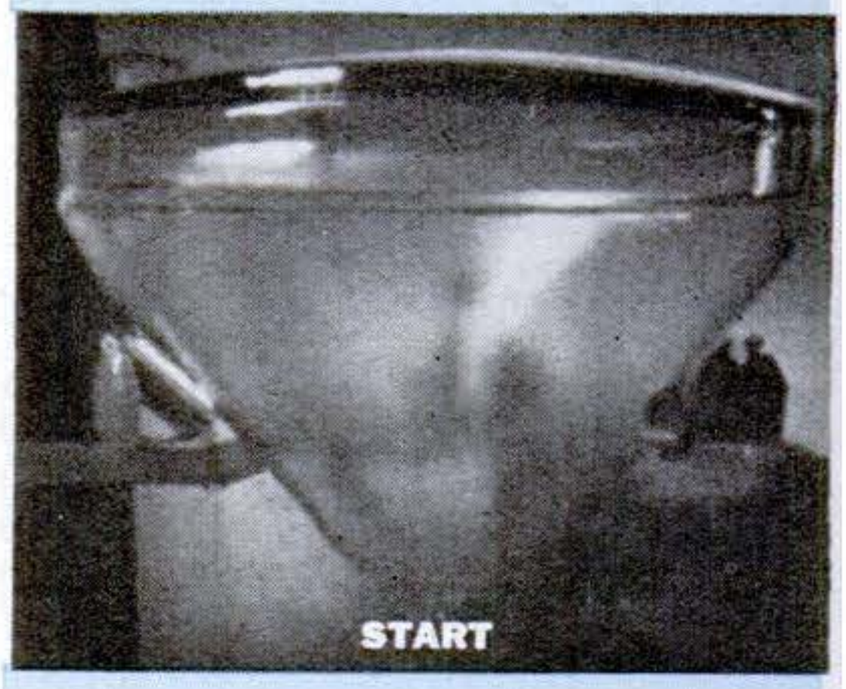
General Electric, pretty much alone, is making 23s that, aside from shape, are identical with the old 21s. The GE sets have the customary safety shield separately mounted in front of the picture tube. GE charges about $10 extra for the new size (over the price of a roughly equivalent 21-inch receiver).

The other TV makers are pushing 23s with a radically different picture tube. It has the safety shield bonded directly to the face of the tube, and requires no separate shield in the cabinet. They are charging premiums (over

You'll see several kinds of 23s. One of them even blocks annoying light reflections



SQUARE-CORNERED SHAPE marks all the new 23-inch picture tubes. Some are made like old 21s, to be used with separate safety shield. But most sets contain Corning's bonded tube (above), which has a glass cap cemented over its face and needs no separate shield mounted in front of it.



Bonded tube is implosion-proof

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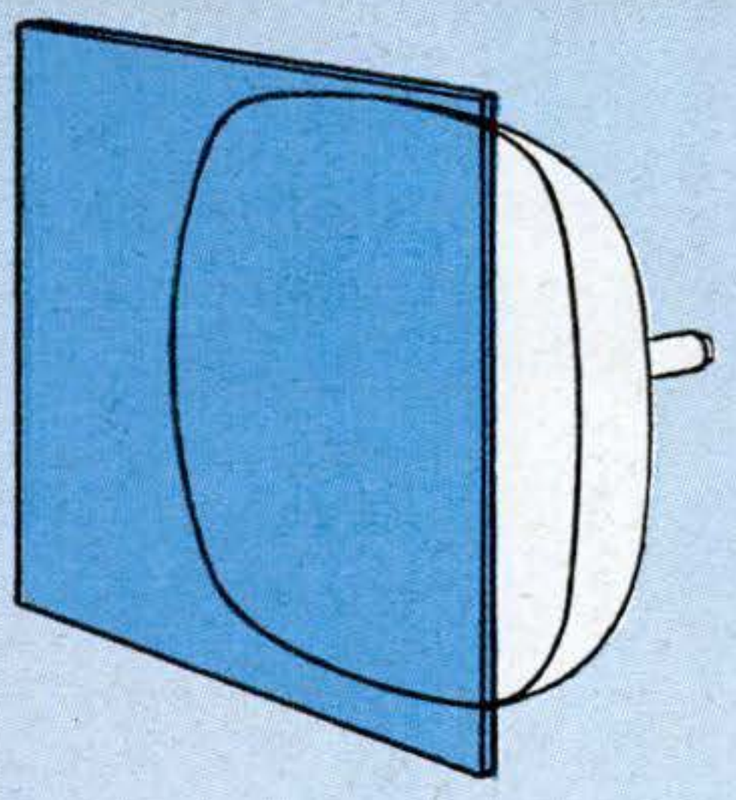
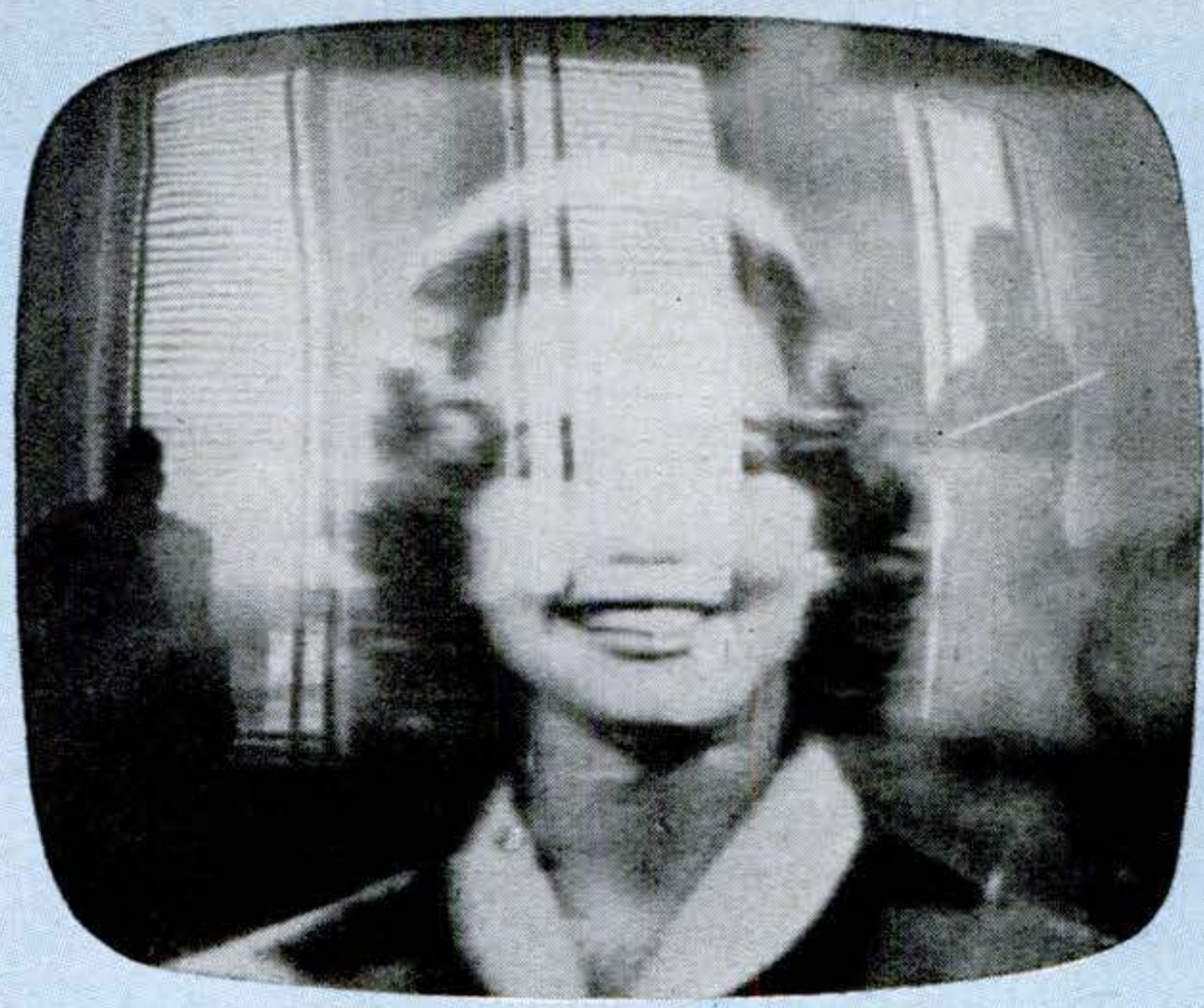
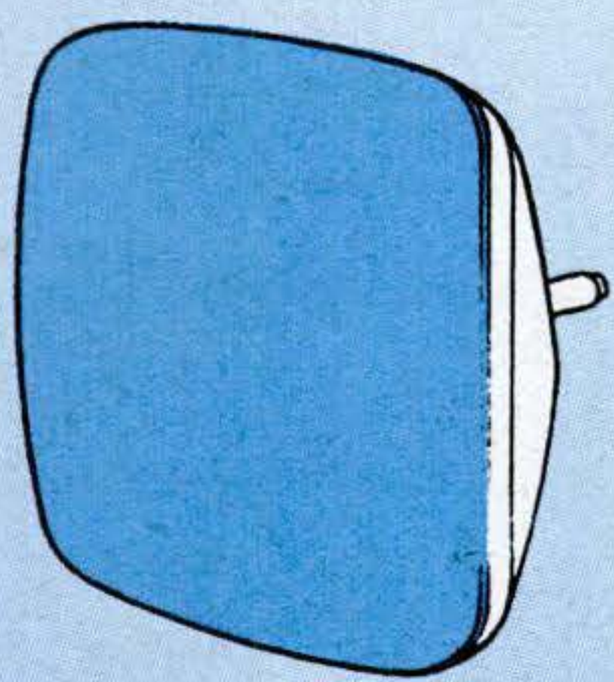




GLARE from windows or lamps may kill picture on old-style screen. It has four glass surfaces—two on tube, two on shield—to reflect light back.



CEMENTING SAFETY SHIELD to tube face reduces number of glass surfaces and cuts light reflection considerably. To wash out reflections entirely, as shown here, some TV makers go a step further and apply a frosted surface to the outside of the bonded shield.

HOW OLD-STYLE TUBE IMPLODES is revealed by movies (2,400 frames per second) of lab test. Cracks spread over faceplate corner, quickly shattering glass into flying fragments. This does happen—though rarely—in TV sets. Bonded tube may also fail, but it won't implode.

CONTINUED

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21-inchers) that range from a nominal $10 up and up. The increase in manufacturing cost between the two types should be small.

The glued-on safety shield does a couple of things for you:

- The picture is somewhat brighter and crisper because internal reflections are reduced. Gluing shield to tube face eliminates glass-to-air surfaces, which reflect light backwards.
- You can maintain a bright, crisp picture more easily because you can wipe dust off the screen more easily. Any warm, electrically active surface—and the picture-tube face is one—picks up dust like a vacuum cleaner. With a bonded tube, the dust collects on the outside. With separate tube and shield, the dust collects on the tube face—behind the shield. You have to take off the shield before you can clean the dust away.

The bonded tube delivers another advantage—one that TV makers are queasy about promoting. It is virtually implosion-proof.

A TV picture tube is a big vacuum bottle under constant stress from atmospheric pressure. The glass weakens over the years (moisture in the air attacks it, widening minute cracks), and it can fail just sitting there in your living room. Failure of the old-style tube causes implosion—it's as though a small grenade went off inside the cabinet. That's why Underwriters Lab requires safety shields and regularly tests their effectiveness.

However—and this is a great big however—the hazard is minute. Around 50 to 100 implosions occur a year, out of more than 50,000,000 TV sets in use. This hazard is eliminated by the bonded tube.

A more realistic worry, if you fix your own TV set, is breakage when the tube is handled *outside* the cabinet. The makers do not claim that implosion is impossible if you drop the bonded tube. They say implosion is much less likely. Service manuals still specify the standard caution, in capital letters: "USE GOGGLES AND GLOVES when removing tube."

How it started. No stunning breakthrough in the research labs led to the

[Continued on page 228]

1961 TV SPECS

	CHASSIS	PICTURE SIZE	APPROXIMATE PRICE	CABINET SIZE (ht. x w. x d. to nearest inch)	WEIGHT (pounds)	PICTURE-TUBE DEFLECTION ANGLE (degrees)
ADMIRAL	15G1	19"	$170	16x19x12	n.a.	114
	15F1	19"	$230	15x23x12	n.a.	114
	20A7	23"	$220	19x26x15	n.a.	110
	18B7	23"	n.a.	20x26x17	n.a.	110
DUMONT	120530	19"	$198	16x22x10	52	114
	120602	23"	$260	20x27x17	94	92
EMERSON	120507	17"	$128	13x18x13	36	90
	120552	19"	$188	16x21x12	68	114
	120564	23"	$198	20x28x16	78	92
	120549	23"	$248	32x35x13[a]	82	110
GENERAL ELECTRIC	M-6	17"[b]	$169	15x21x12	40	110
	U-5	23"	$450	30x47x18[a]	n.a.	114
MAGNAVOX	34	19"[c]	$190	n.a.	n.a.	110
	33	21"[d]	$220	n.a.	n.a.	90
	30	23"[e]	$340	n.a.	n.a.	110
MONTGOMERY WARD	4225	19"	$170[f]	16x22x13	37	114
	4224	19"	$185[f]	16x22x13	37	114
	5202	23"	$220[f]	32x34x20[a]	81	92
	5203	23"	$280[f]	34x36x18[a]	93	110
MOTOROLA	TS 435	19"	$200	18x23x13	52	110
	TS 432[g]	19"	$363	16x18x13	40	114
	TS 568	23"	$230	19x28x20[a]	95	90
	TS 569	23"	$430	33x33x18[a]	125	110
OLYMPIC	KV/KZ	19"	$180	n.a.	n.a.	114
	KA	21"	$180	n.a.	n.a.	90
	KB/KC/KD	23"[e]	$220	n.a.	n.a.	92
	KE	23"	$250	n.a.	n.a.	92
PACKARD-BELL	V8-9	17"[h]	$180	16x22x8	37	114
	88-8	19"[i]	$250	16x23x8	65	114
	98D10	23"	$340	35x31x17[a]	110	114
PHILCO	11J27	19"	$170	16x19x12	37	114
	11N51	19"	$200	16x22x15	59	114
	11N51A	23"	$240	21x30x15	84	110
RCA	KCS134	19"	$200	17x24"13	55	114
	KCS131	21"	$200	20x28x20	85	90
	KCS132	23"	$220	20x30x16	95	110
SEARS, ROEBUCK	1100	17"	$130[f]	15x18x17	30	90
	1122	19"	$160[f]	14x21x9	40	114
	1130	21"	$200[f]	20x30x15	62	90
	1160	23"	$260[f]	34x29x11[a]	86	114
SETCHELL-CARLSON	C-106A	17"	$189	13x16x9	32	110
	361	19"[c]	$199	16x24x13	49	114
	X-159	23"	$309	31x28x13[a]	69	114
	159	23"[j]	$399	35x24x18[a]	105	92
SYLVANIA	547	17"	$150	14x16x15	34	110
	552	19"	$190	17x23x11	40	114
	550	23"	$200	21x25x13	78	110
WESTING-HOUSE	V-2412	19"	$190	16x20x12	39	114
	V-2409	19"	$200	16x24x13	47	114
	V-2411	23"	$250	20x29x17	71	114
ZENITH	16F25	17"	n.a.	15x21x11	52	110
	16F27	19"	$190	16x22x12	52	114
	16F21	21"	$190	21x23x18	82	90
	16F23	23"	$230	20x27x17	90	92

NOTES: n.a., information not available; [a] Console; [b] Same chassis available with 19", 21", or 23" picture tube; [c] Same chassis available with 23" picture tube; [d] Same chassis available with 23",

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HIGH VOLTAGE (KV—no beam current)	HIGH VOLTAGE (KV—normal beam current)	AUTOMATIC FINE TUNING	LOCATION OF TUNING CONTROLS	NUMBER OF IF AMPLIFIER STAGES	IF BANDWIDTH (megacycles)	NUMBER OF TUNED CIRCUITS IN IF	AGC TYPE	INTERFERENCE FILTERS	TUNER	TRANSFORMER POWER SUPPLY	PICTURE-TUBE SAFETY SHIELD	POWER-SURGE LIMITING RESISTOR	OFF-ON SWITCH WITHOUT CHANGING VOLUME CONTROL	PRINTED CIRCUITS USED	NUMBER OF TUBE FUNCTIONS
17.0	16.0	none	top	2	3.0	6	keyed	1 IF trap	tetrode	no	separate	no	no	yes	17
17.0	16.0	none	top	2	3.0	6	keyed	1 IF trap	tetrode	yes	separate	no	yes	yes	14
23.0	21.5	preset	front	3	3.75	9	keyed	1 IF trap	neutrode	yes	bonded	no	yes	yes	20
23.0	21.5	none	front	3	3.75	8	keyed	1 IF trap	tetrode	yes	bonded	no	no	yes	18
16.0	15.0	yes	front	3	3.5	7	keyed	1 IF trap	neutrode	yes	separate	no	yes	yes	19
20.0	19.0	yes	front	3	3.5	9	keyed	2 IF traps, 1 FM trap	neutrode	yes	bonded	no	yes	no	20
13.5	12.5	none	front	3	3.5	6	simple derived	1 IF trap	tetrode	no	separate	yes	yes	yes	18
16.0	15.0	none	front	3	3.5	7	keyed	1 IF trap	tetrode	yes	separate	no	yes	yes	19
18.0	17.0	none	front	3	3.5	6	simple derived	2 IF traps, 1 FM trap	neutrode	no	bonded	yes	yes	yes	18
18.0	17.0	none	front	3	3.5	7	keyed		neutrode	yes	bonded	no	yes	yes	19
17.5	16.5	none	front	3	3.25	6	simple derived	none	tetrode	yes	separate	yes	yes	yes	20
19.5	18.5	none	front	3	3.25	8	keyed	none	cascode	yes	separate	yes	yes	yes	22
17.5	n.a.	none	front	3	3.5	8	keyed	2 IF traps	neutralized triode	yes	separate	no	yes	no	21
17.5	n.a.	none	front	3	3.5	8	keyed	2 IF traps		yes	separate	no	yes	no	19
20.0	n.a.	none	front	3	3.5	8	keyed	2 IF traps		yes	separate	no	yes	no	22
15.5	14.5	none	front	2	3.45	7	simple derived	1 IF trap	cascode	no	separate	yes	no	no	16
15.5	14.5	none	front	2	3.45	7	keyed	1 IF trap	cascode	no	separate	yes	yes	no	18
16.5	15.3	none	front	2	3.45	7	simple derived	1 IF trap	cascode	no	bonded	yes	no	no	16
17.5	16.2	preset	front	3	3.25	8	keyed	1 IF trap, 2 FM traps	neutrode	yes	bonded	no	yes	no	20
20.0	19.0	preset	front	3	3.6	11	keyed	1 high pass, 1 FM trap	cascode	no	bonded	yes	no	yes	19
15.0	15.0	none	top	3	3.5	11	keyed		g	yes	separate	g	no	no	g
23.0	22.0	preset	front	3	3.6	11	keyed		cascode	yes	bonded	yes	yes	no	20
20.0	19.0	preset	front	3	3.6	11	keyed		cascode	yes	bonded	yes	yes	no	20
18.0	17.0	none	top	2	3.0	5	keyed	1 high pass	tetrode	yes	separate	no	no	no	16
18.0	17.0	none	front	2	3.0	5	simple derived	1 high pass	tetrode	yes	separate	no	no	no	15
19.0	18.5	none	front	2	3.0	6	keyed	1 high pass	tetrode	yes	separate	no	yes	no	16
20.0	19.5	none	front	3	3.75	7	keyed	1 high pass	cascode	yes	separate	no	yes	no	17
16.0	15.0	none	front	3	3.25	5	simple derived	1 IF trap	tetrode	no	separate	no	no	no	18
17.0	16.0	none	front	3	3.25	6	keyed	1 IF trap	neutralized triode	yes	separate	no	yes	no	20
20.0	19.0	none	front	3	3.25	8	keyed	1 high pass		yes	separate	no	yes	no	24
18.0	17.0	none	top	3	3.25	8	amplified	1 IF trap	tetrode	no	separate	yes	no	yes	18
18.5	17.5	none	front	3	3.25	8	keyed	1 IF trap	cascode	yes	separate	no	yes	yes	20
20.0	19.0	none	front	3	3.25	8	keyed	1 IF trap	cascode	yes	bonded	no	yes	yes	20
18.0	17.4	none	front	3	3.25	6	keyed	2 IF traps, 1 high pass	neutralized triode	yes	bonded	yes	yes	yes	19
20.0	19.0	none	front	3	3.25	8	keyed			yes	separate	yes	yes	yes	22
20.0	19.4	none	front	3	3.25	8	keyed			yes	bonded	yes	yes	yes	22
14.0	12.5	none	side	2	3.0	5	simple derived	none	tetrode	no	separate	yes	no	yes	17
14.0	12.5	none	front	2	3.0	5	simple derived	1 IF trap	tetrode	no	separate	yes	no	yes	17
16.5	15.0	yes	front	3	3.2	6	simple derived	none	tetrode	no	separate	yes	yes	yes	18
16.5	15.0	yes	front	3	3.2	6	keyed	1 IF trap	tetrode	no	bonded	yes	yes	yes	18
15.0	14.0	none	top	3	3.7	9	keyed	1 high pass	cascode	yes	separate	yes	no	no	22
17.5	16.5	none	front	3	3.7	9	keyed	1 high pass	cascode	yes	separate	yes	yes	no	22
17.5	16.5	none	front	3	3.8	11	keyed	1 high pass	cascode	yes	bonded	yes	yes	no	27
18.0	17.0	none	front	3	3.8	11	keyed	1 high pass	cascode	yes	bonded	yes	yes	no	27
17.5	16.6	none	top	3	3.5	8	keyed	1 IF trap, 1 low pass	neutrode	no	separate	yes	yes	yes	19
16.2	15.3	none	top	3	3.5	8	keyed		neutrode	no	bonded	yes	yes	yes	19
17.5	16.6	preset	top	3	3.5	8	keyed		neutrode	no	bonded	yes	yes	yes	19
15.5	14.7	no	front	3	3.3	10	simple derived	1 IF trap	neutrode	no	separate	yes	yes	yes	18
15.5	14.7	yes	front	3	3.3	10	simple derived	1 IF trap	neutrode	yes	separate	no	yes	yes	18
17.0	16.1	yes	front	3	3.3	10	keyed	1 IF trap	neutrode	yes	separate	no	yes	yes	19
16.0	15.3	none	front	3	3.15	10	keyed	2 high pass	cascode	yes	separate	no	yes	no	20
18.0	17.2	none	front	3	3.15	10	keyed	2 high pass	neutralized triode	yes	separate	no	yes	no	19
20.0	19.1	none	front	3	3.3	10	keyed	2 high pass		yes	separate	no	yes	no	19
20.0	19.1	none	front	3	3.3	10	keyed	2 high pass		yes	bonded	no	yes	no	19

24", or 27" picture tube; [e] Same chassis available with 24" picture tube; [f] Catalogue price, shipping extra; [g] All-transistor (no tubes) battery-operated portable; [h] Same chassis available with 19" or 23" picture tube; [i] Same chassis available with 21" or 23" picture tube; [j] Same chassis available with 24" or 27" picture tube.

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Go-Devil Walks,

AN UNGAINLY 7,500-pound iron-and-steel monster that rolls, walks, crawls, climbs, and floats has been skittering over terrain that no other vehicle would dare attempt.

The Go-Devil can travel over logs, stumps, boulders, and ditches; through mud, sand, and water; up river banks and along steep slopes. Secret of its versatility is hydraulically operated wheel mounts that swivel 360 degrees.

A 195-hp. Ford V-8 engine with chain drive turns all four wheels. The body is hinged at the middle to give the machine an 18-foot turning circle.

The pilot model, an all-purpose passenger vehicle, is 23 feet long, 6½ feet wide, and has 3½-foot maximum clearance. Wagner Tractor, Portland, Ore., is designing new, specialized versions for forestry, hunting, side-hill farming, exploring, and military use.—*Ellis Lucia.*

CHASSIS REMAINS LEVEL while negotiating a 37-degree hill. Go-Devil safely travels along slopes as steep as 45 degrees with reasonable speed.

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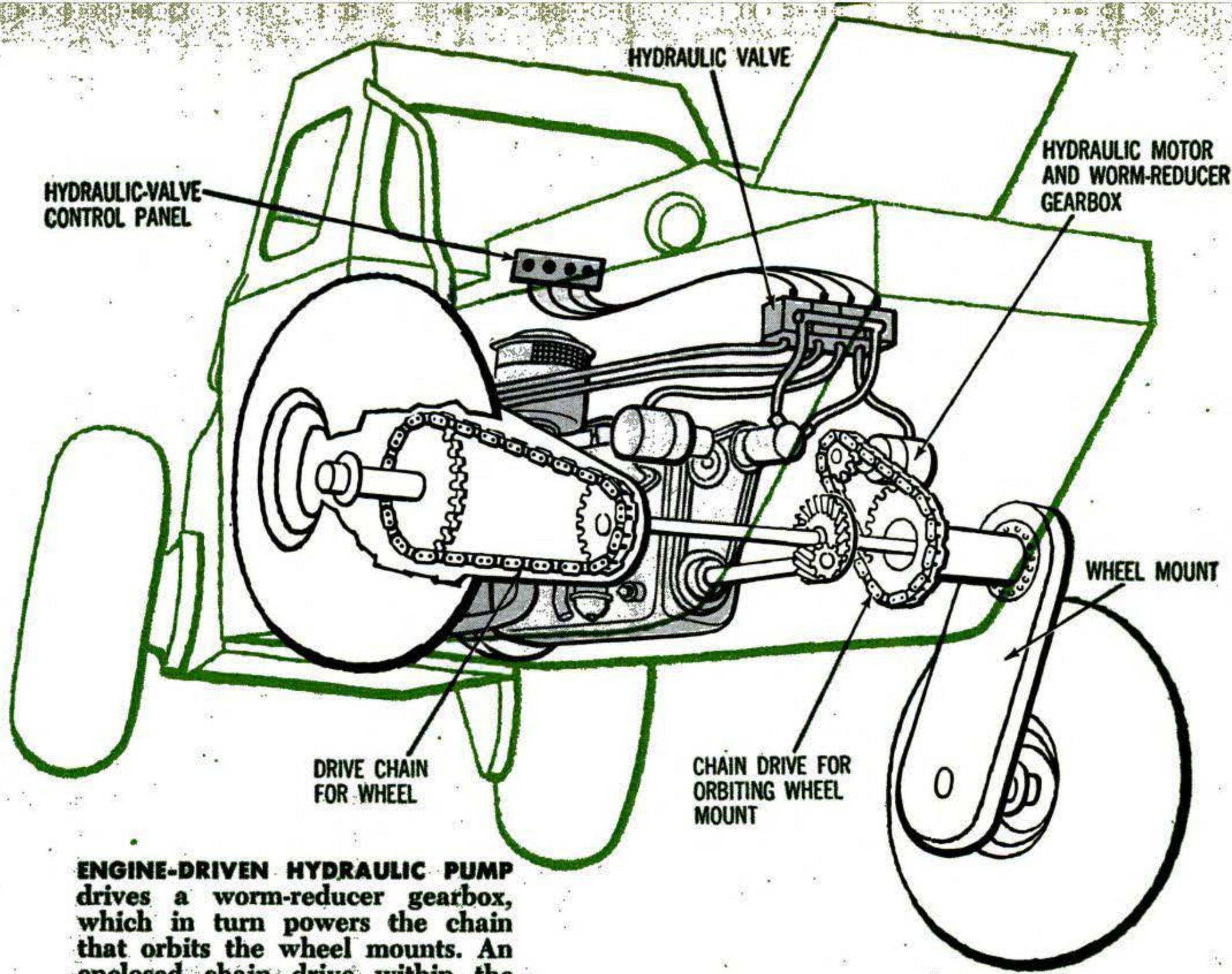

ENGINE-DRIVEN HYDRAULIC PUMP drives a worm-reducer gearbox, which in turn powers the chain that orbits the wheel mounts. An enclosed chain drive within the mounts rotates each wheel.

Crawls, and Swims

REAR-MOUNTED PROPELLER comes into use for water travel. Full afloat, the wheels can be lowered to cross sand bars or shallows.

SIX-FOOT BANK is child's play for the Go-Devil. Shortcoming of other amphibious craft is their inability to climb steep river banks.

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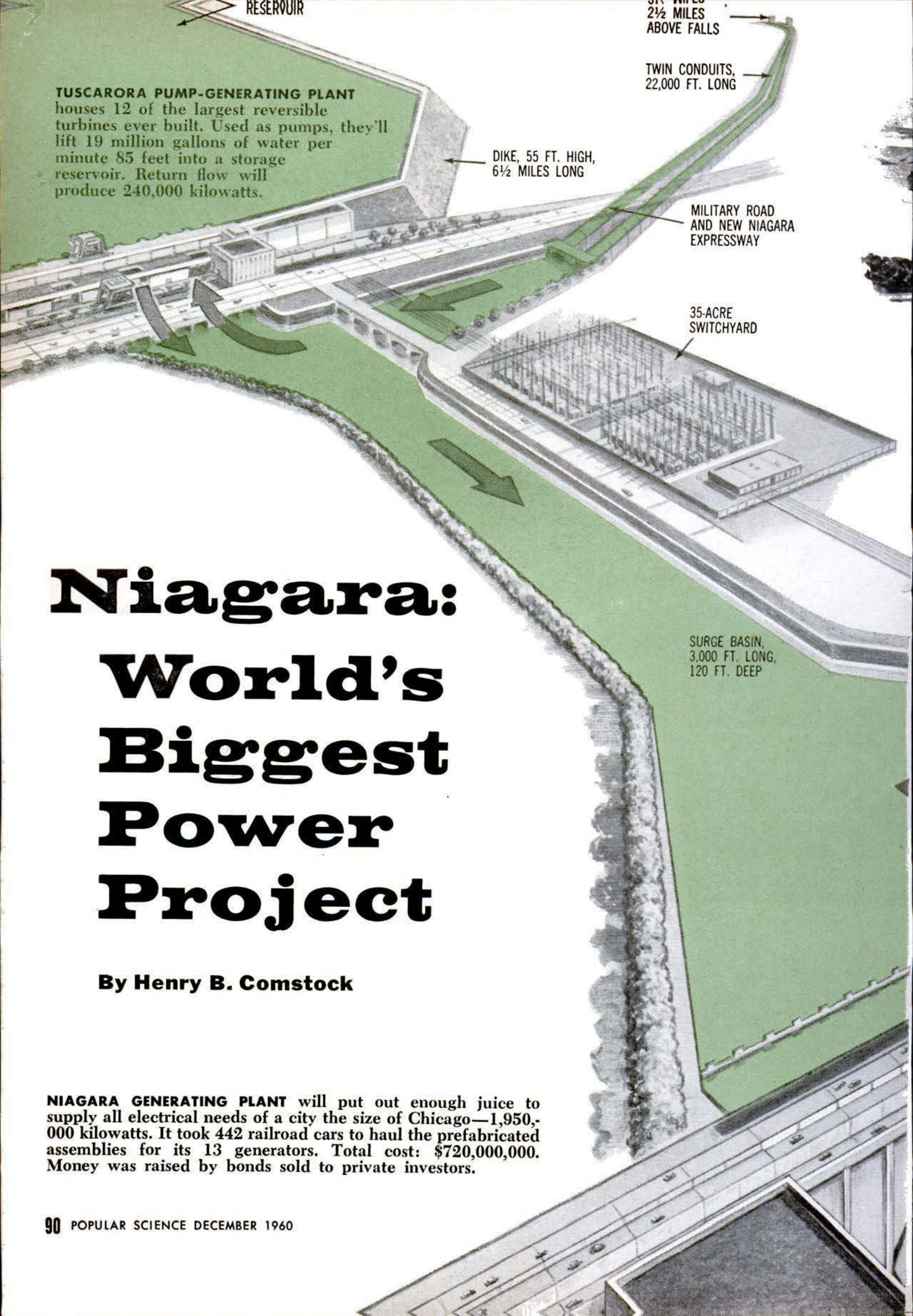

Niagara: World's Biggest Power Project

By Henry B. Comstock

NIAGARA GENERATING PLANT will put out enough juice to supply all electrical needs of a city the size of Chicago—1,950,000 kilowatts. It took 442 railroad cars to haul the prefabricated assemblies for its 13 generators. Total cost: $720,000,000. Money was raised by bonds sold to private investors.

THE honeymoon is almost over for 24 million gallons of water a minute now crashing wastefully over Niagara Falls.

This loss of four million potential horsepower will end dramatically next February. At that time two huge hydroelectric plants now nearing completion below the cataract will begin to create power. Together, they'll pour the greatest flow of kilowatts ever generated at a single power site into thousands of miles of transmission lines spiderwebbing the Niagara frontier.

The big show will start at a pair of towering intake structures on the upper

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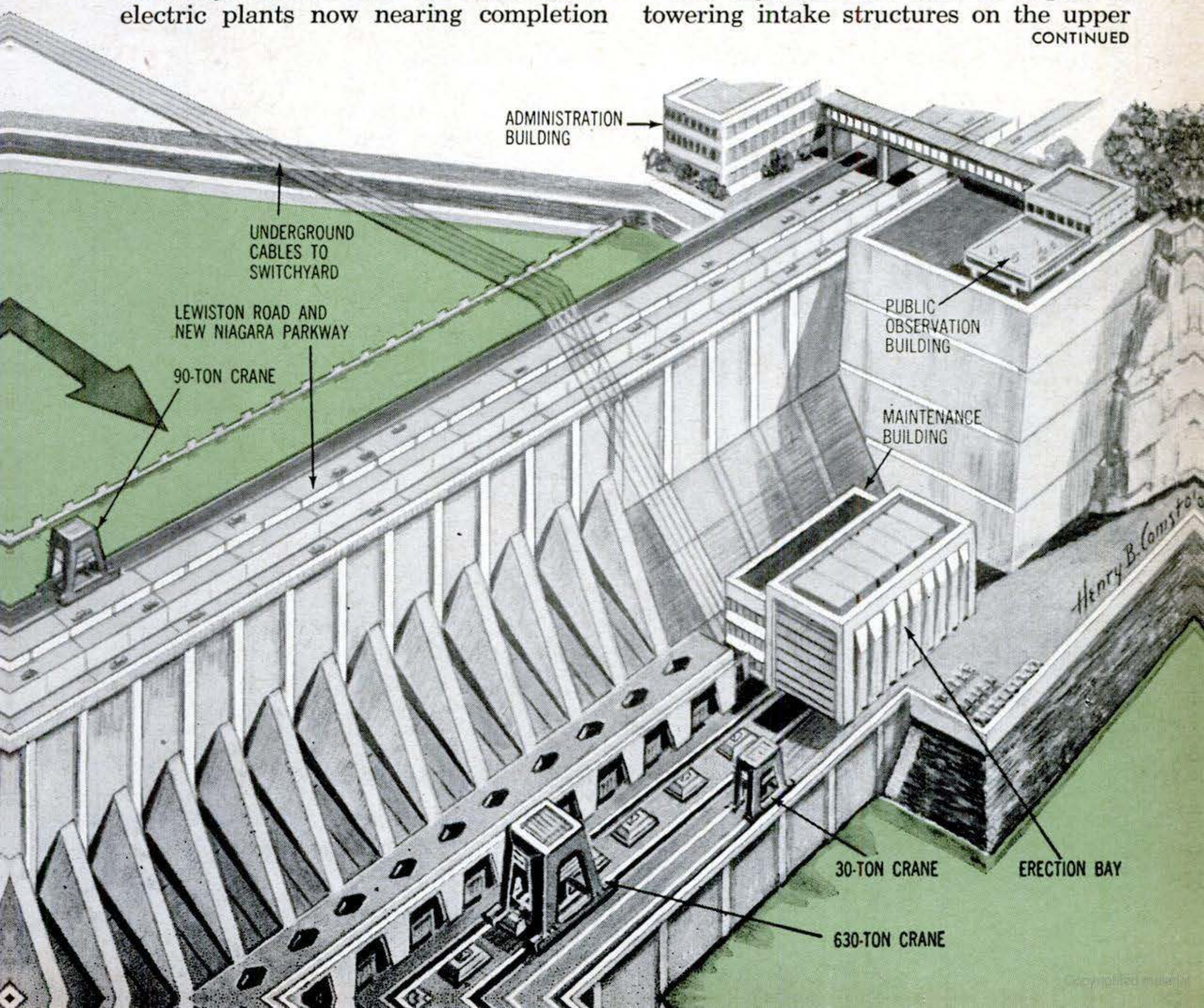


It's a gigantic version of the old Chinese water wheel that scooped up little bucketfuls to irrigate the fields

Niagara River, 2½ miles above the Falls. Inside these concrete monoliths, steel lift gates will be hoisted 68 feet from the floor of the river. A surge of water combed free of trash and ice will boil under the gates. It will enter two concrete tunnels, each large enough to accommodate six double-track railroad lines. Gliding through these giant conduits, the two-pronged flood will pass directly under the city of Niagara Falls—reaching a maximum depth of 100 feet to maintain a nearly level course.

Four miles from the intake gates, the water will re-surface, filling an hourglass-shaped canyon blasted 120 feet down through bedrock. At the far end of the basin its flow will be halted, briefly, by over a million cubic yards of reinforced concrete, poured into the larger of two dams.

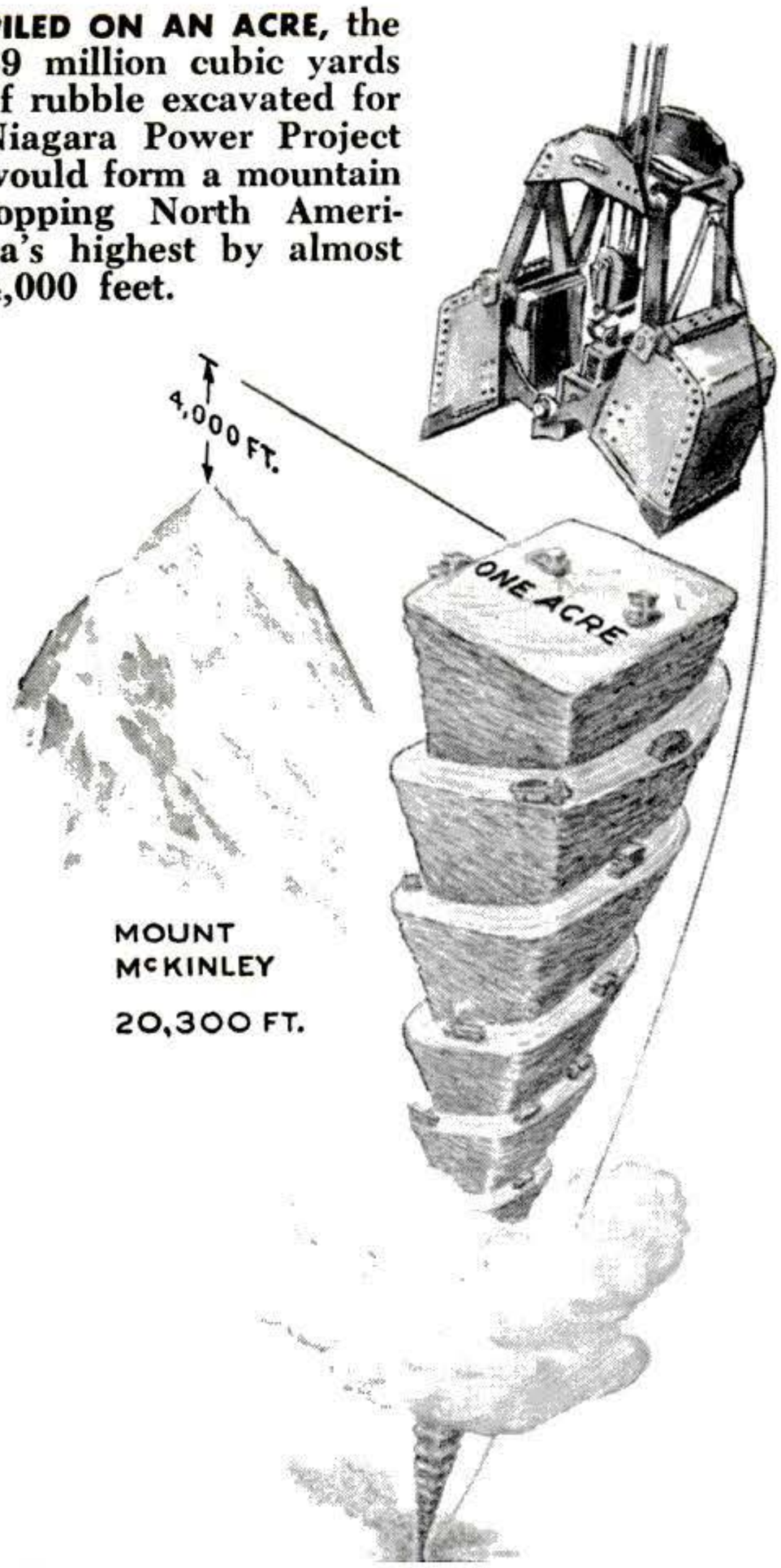
This $177-million structure—the backbone of the new Niagara Generating Plant—is shouldered against the cliffs on the American side of the lower gorge. Its 580-foot-wide base runs for over a third of a mile along the rapids. The conduit-delivered water will level off 365 feet above and behind it.

Then, at the flick of a switch, the head gate of a 24-foot-diameter sluice will open, jetting a torrent headlong down the core of the dam, through the scroll case of a 200,000-horsepower turbine, and into the river beyond. Simultaneously, the largest generator ever built will start grinding out 150,000 kilowatts. Twelve identical units will add their output to the plant's collective 1,950,000 kilowatts as fast as they can be cut in.

Switchyard. The 13,800-volt juice will go first to a bank of transformers at the base of the dam. There it will be stepped up to 115,000 and 230,000 volts, for delivery to a collecting switchyard forested with nearly 300 transmission towers. The yard will dispatch current to important cities and industrial sites.

In the yard, too, a special bank of transformers will shoot the highest of the high lines hot with a sizzling 345,000 volts. Two such circuits will take off for Rochester, N.Y., then slim down to one for a tie-in with a line of the St. Lawrence Power Project near Utica. When winter ice slows down the electrical output of the big Robert Moses Plant at Massena, N.Y., Niagara will make up the deficit. And in summer, when the flow of water through the Niagara plant must be restricted to provide scenic awe for tourists at the Falls, Massena will help to balance the books.

Only half the story. All this is fine, as far as it goes. But when plans for the Niagara project were drawn up, the Power Authority of the State of New York was looking for still another way to help lick the problem of a fluctuating water supply at the Falls. In a 1950 treaty with Canada it was agreed that our countries would share the river's power potential on an equal basis. It was also stipulated that a flow of at least 100,000 cubic feet a second should be maintained at the Falls during the daylight hours of the tourist season. At other times, it could be reduced to 50,000.



PILED ON AN ACRE, the 39 million cubic yards of rubble excavated for Niagara Power Project would form a mountain topping North America's highest by almost 4,000 feet.

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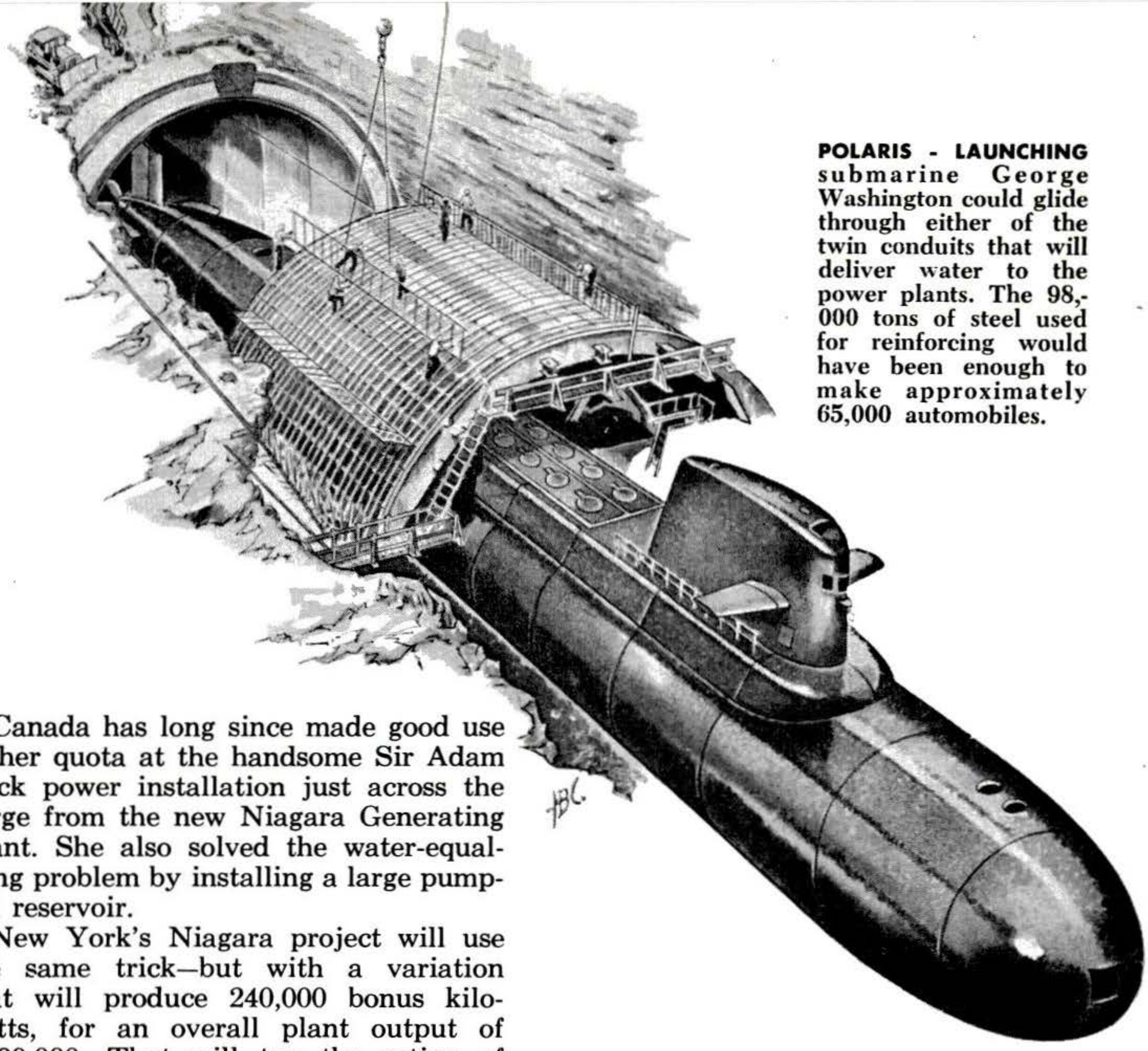

POLARIS - LAUNCHING submarine George Washington could glide through either of the twin conduits that will deliver water to the power plants. The 98,000 tons of steel used for reinforcing would have been enough to make approximately 65,000 automobiles.

Canada has long since made good use of her quota at the handsome Sir Adam Beck power installation just across the gorge from the new Niagara Generating Plant. She also solved the water-equalizing problem by installing a large pump-fed reservoir.

New York's Niagara project will use the same trick—but with a variation that will produce 240,000 bonus kilowatts, for an overall plant output of 2,190,000. That will top the rating of today's biggest dam—Grand Coulee—by 216,000 kilowatts.

The wizardry that does the job. An educated version of the old Chinese irrigation wheel will move the water. The Chinese made rivers lift themselves by their bootstraps with the help of two sets of paddles mounted on a single shaft. Turned by the current, one spun the other, which scooped up little bucketfuls of water and dumped them into the fields above.

In the New York version a portion of the juice generated by the big Niagara plant at night and during the seasons when water is plentiful will be shoved 3,000 feet back through the switchyard, and on to a second power plant at the upstream end of the conduit-fed surge basin. This $58-million structure is no mean slab of concrete, either. It's 160 feet high and 974 feet long—the gigantic gateway to a high-diked reservoir covering 1,880 acres. Like the Niagara plant, it has a battery of penstocks. But in place of conventional generators and turbines, it houses 12 reversible "pump-generators."

As current from the switchyard flows into their electrical units, each will become a 37,000-horsepower motor. These will spin the turbines backward, turning them into giant pumps. Up the penstocks will go part of the water entering the basin, at a rate of 19 million gallons a minute. That's enough to fill 66,000 15-by-30-foot swimming pools an hour.

Once the reservoir is filled, the beauty of the whole project becomes obvious:

During tourist periods, the reservoir will dump water down the chutes and the electrical units will become generators, combining their output with that of the Niagara plant to compensate for reduced flow.

At other times, pump-generators will bring the reservoir back to working level, while the Niagara plant cranks out full power—enough to light 19½ million 100-watt bulbs.

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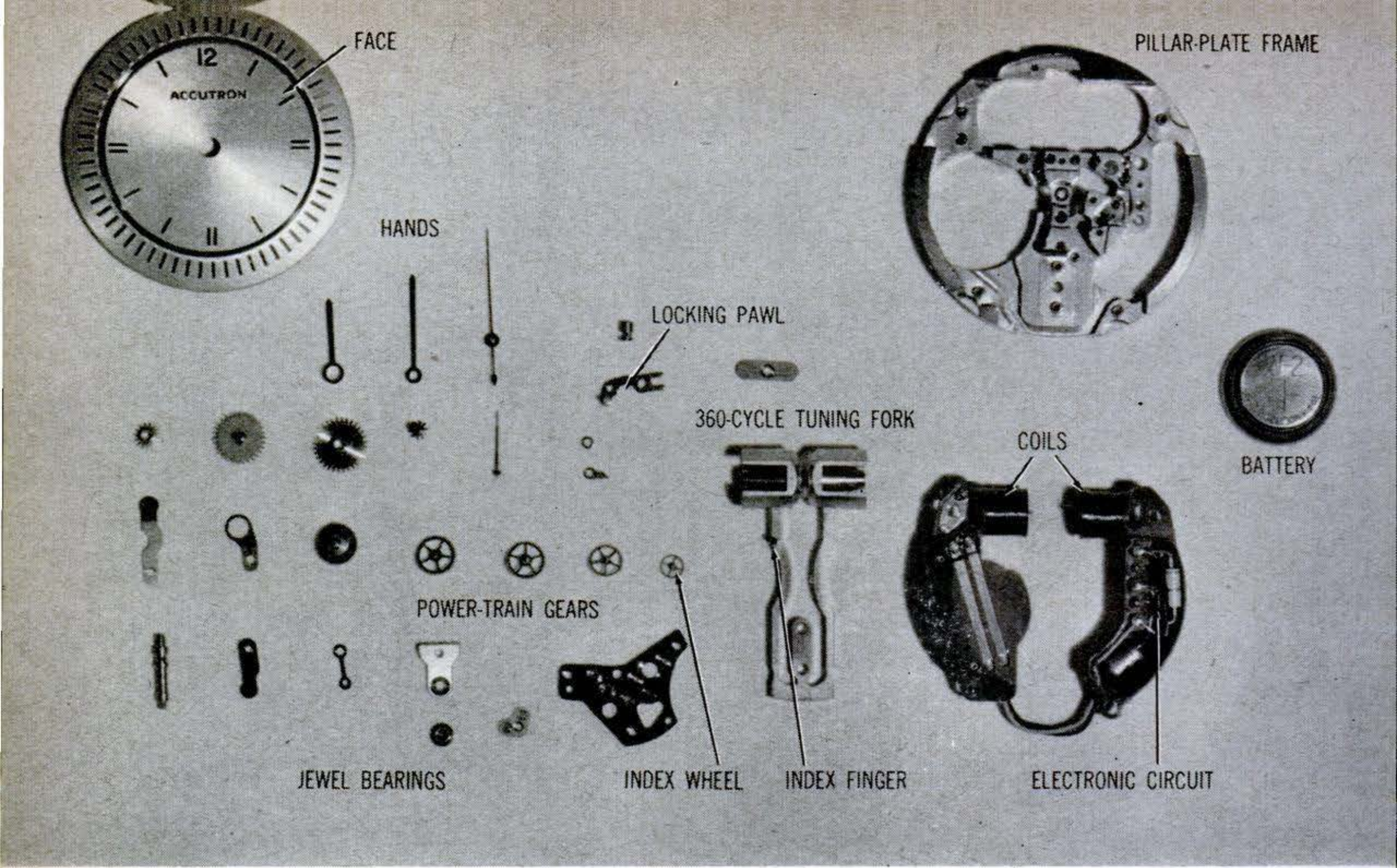


It hums instead of ticks...

Electronic Watch Keeps Almost Perfect Time

YOU hear no tick from the world's most accurate watch. It hums (a faint, out-of-tune F-sharp). The hum comes from a tuning fork, similar to the ones used by music teachers but only an inch long.

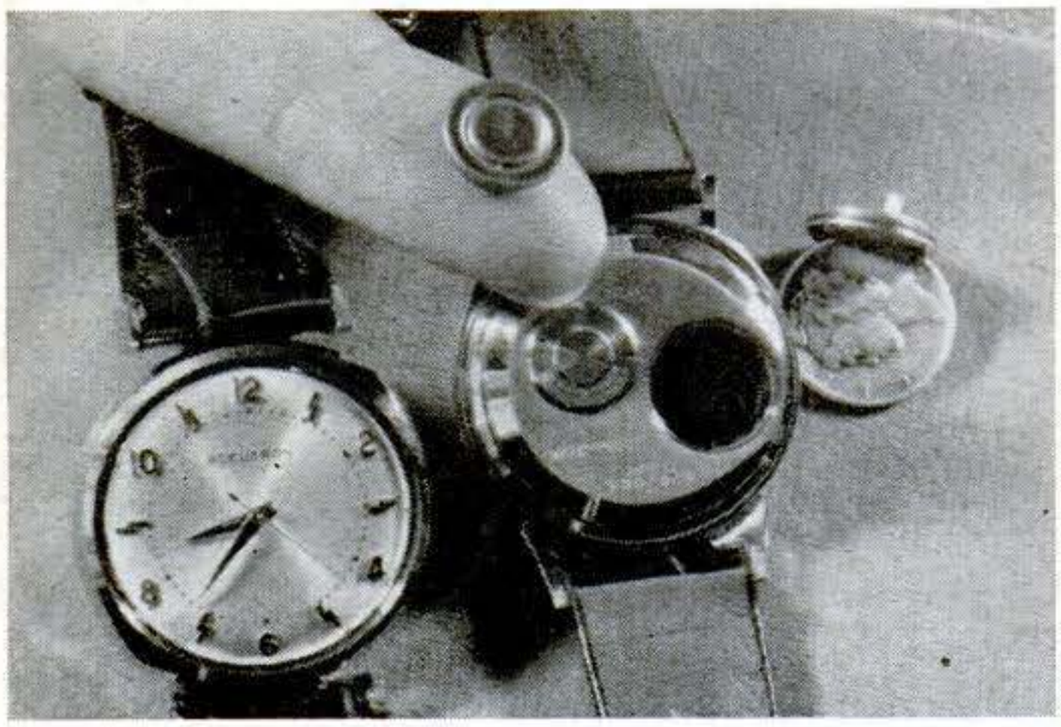
That tuning fork is the secret of the new watch's remarkable precision: It is guaranteed not to gain or lose more than one minute per *month*. The fork keeps so much better time than an oscillating balance wheel, standard in all watches for three centuries, because:

1. It vibrates hundreds of times faster and recovers quickly from shocks.

2. Its vibration rate varies less as the watch is turned and twisted on the wrist. And the small "position error" that remains is identical in every Bulova Accutron watch made.

You never have to take this watch in for cleaning. Bulova warns against routine maintenance. There is no mainspring to exert torque on bearings and cause wear. Lack of oil doesn't make any difference. Repairs, if necessary, can be made by local jewelers.

Minute-a-month accuracy comes high. **Prices start at $175, for the plain-Jane stainless-steel model, and soar to $2,500 for platinum.**



SINGLE MERCURY CELL, adapted from hearing-aid type, powers new electronic watch. It lasts a year (replacement is $1.50). Fold-down handle on the back of the watch sets the hands.

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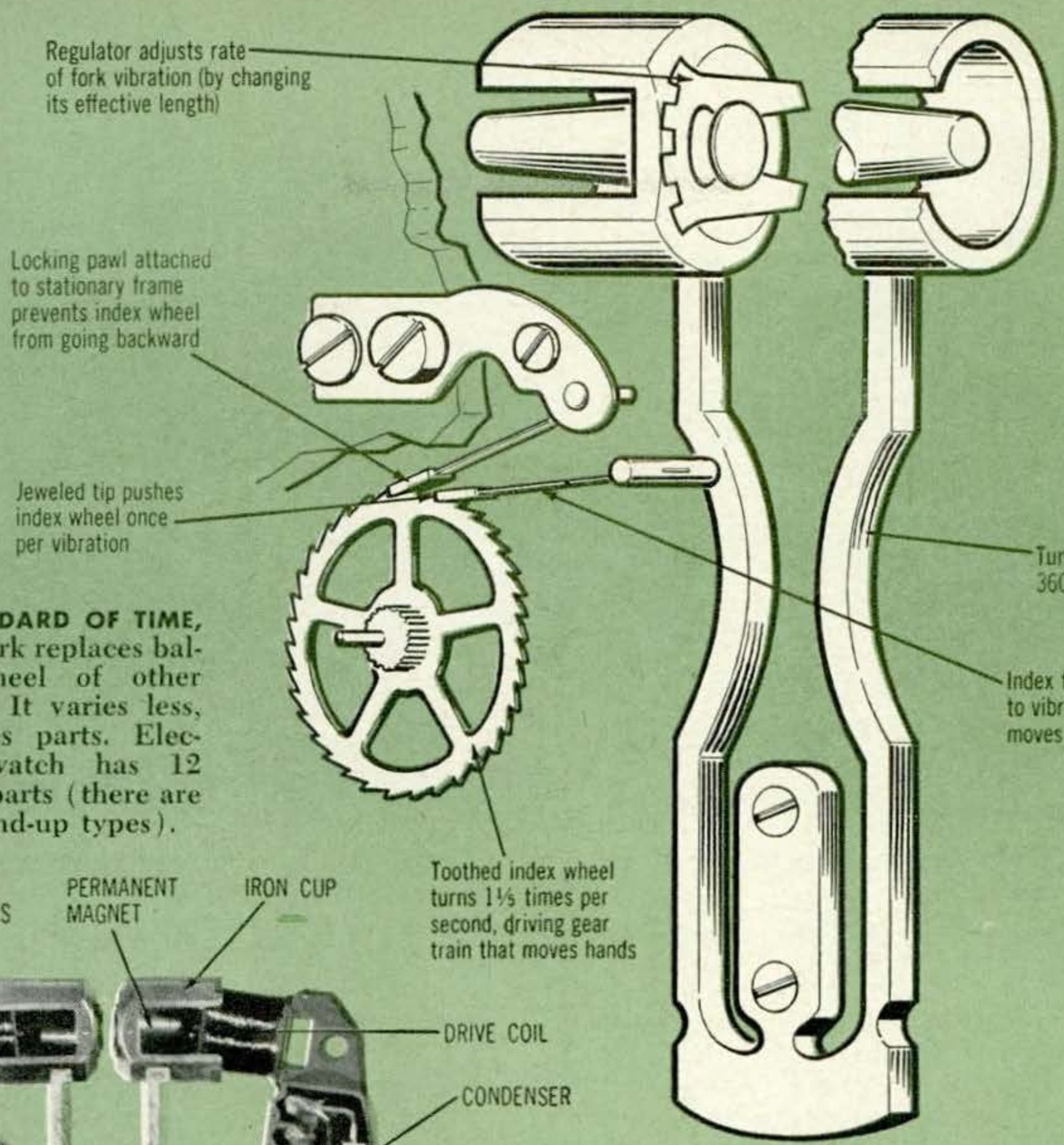
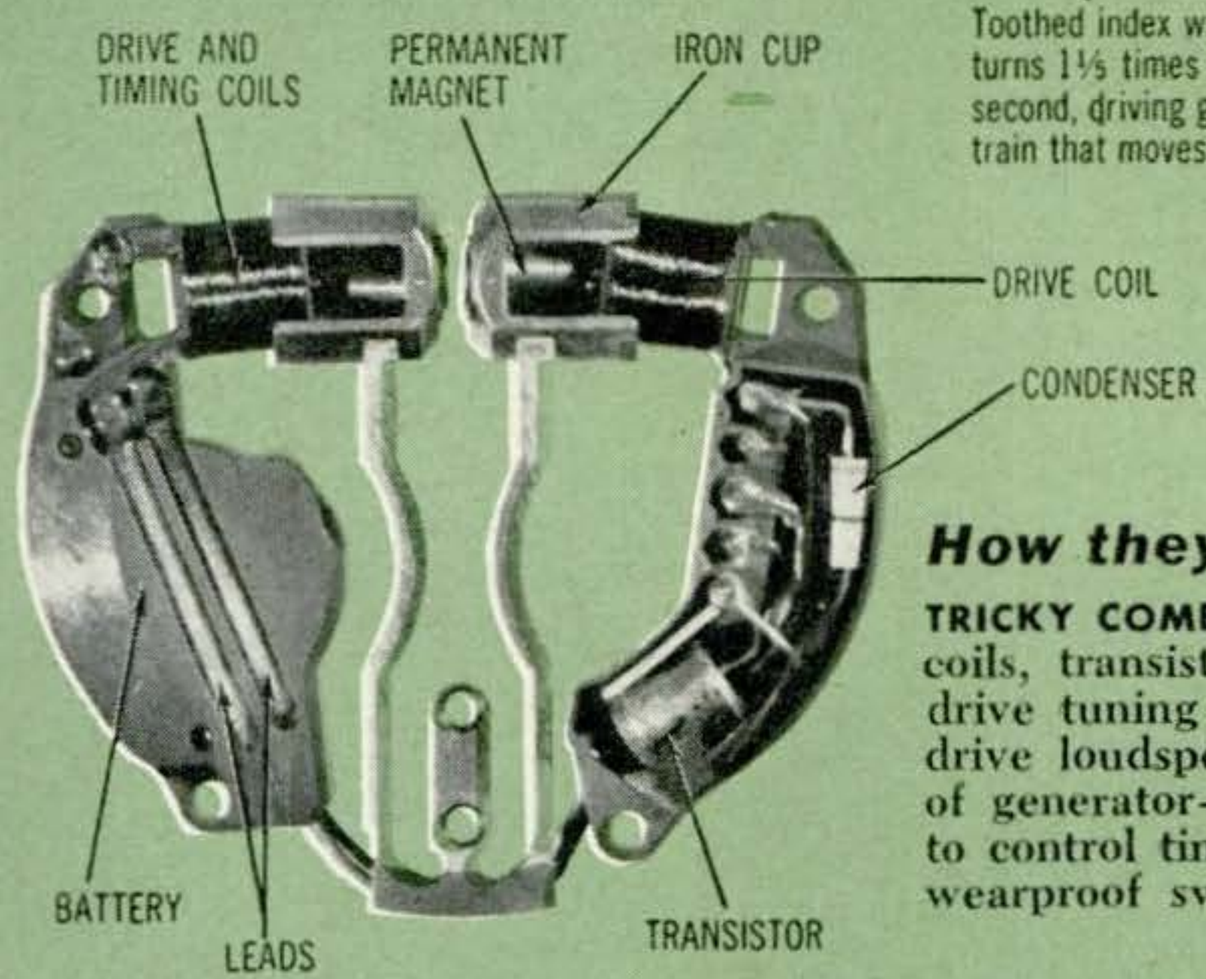
How they make a vibrating tuning fork turn the watch hands

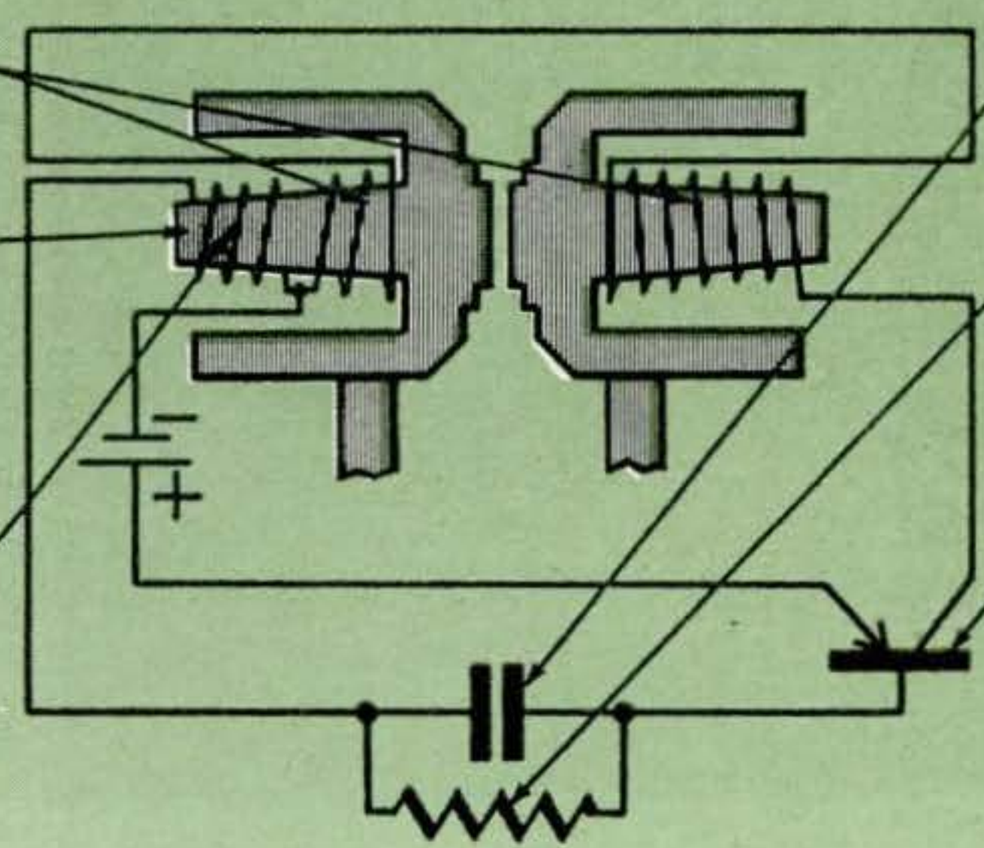


AS STANDARD OF TIME, tuning fork replaces balance wheel of other watches. It varies less, eliminates parts. Electronic watch has 12 moving parts (there are 19 in wind-up types).



How they keep the tuning fork vibrating

TRICKY COMBINATION of permanent magnets, electromagnet coils, transistor, and condenser guarantees precision. Coils drive tuning fork to keep it vibrating, just as similar coils drive loudspeaker cones. But these coils also serve as part of generator—moving magnets generate electricity in them to control timing and strength of drive pulses. Transistor is wearproof switch; it doesn't amplify.



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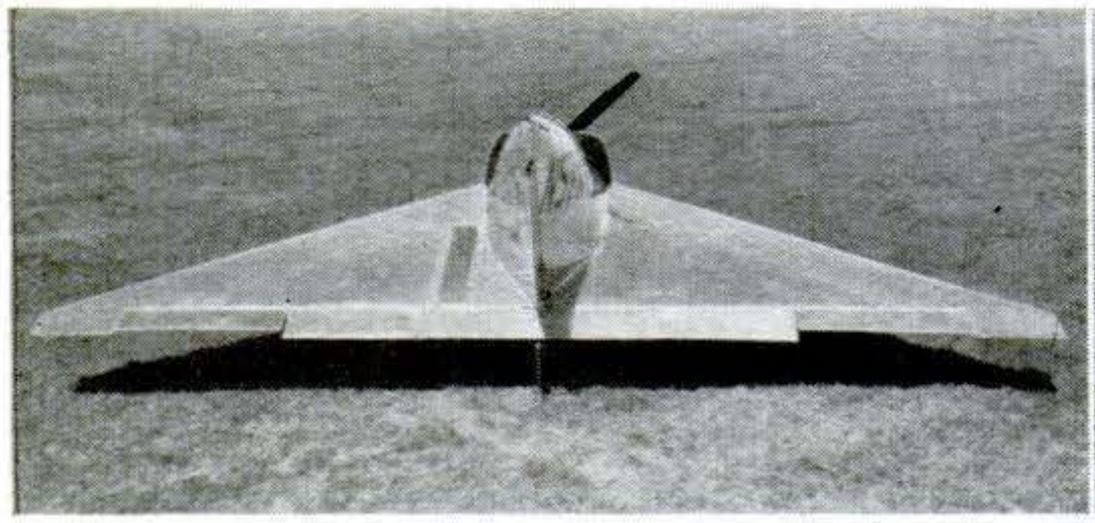
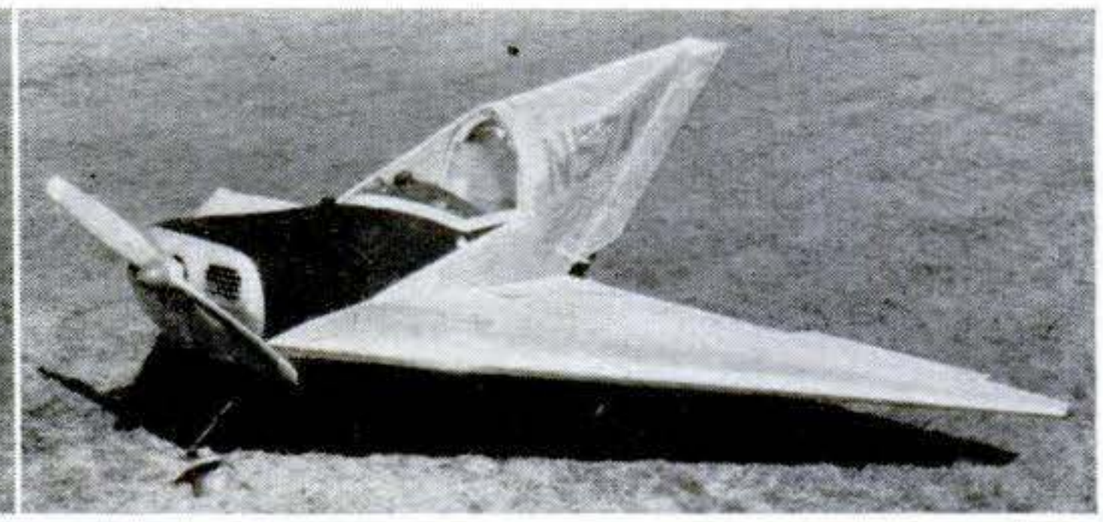
Home-built delta wing is shown in the air on first flight.

Builder chats with test pilot.



Rear view shows configuration of delta wing.



The single-seat plane has cost $1,500 to date.

Homemade delta-wing plane takes to the air

Marion Baker, a 32-year-old flight mechanic at Wright-Patterson Air Force Base in Ohio, got the idea for this delta-wing plane back in 1952. By 1957 he was ready to take it off the drawing board and start building it. The job, carried on during his spare time, took him until last summer, when he got a friend, Ollie Arguilla, an Air Force test pilot, to take it up on a tryout.

The MB-1 is all-metal. Parts were formed over wood patterns and riveted together. The wingspan is 18 feet, with a sweepback of 45 degrees to make the delta wing. An 85-hp. engine gives the plane a cruising speed of 127 m.p.h.

Boy-built stern-wheeler

This little river boat wasn't designed for the Mississippi. It was built by young Jimmy Fench of Bradenton, Fla., for fishing on the Braden River. He reports that it makes nine m.p.h. and can manage water only three inches deep. It is powered by a three-hp. lawn-mower engine. Cost of the wooden stern-wheeler was about $50.

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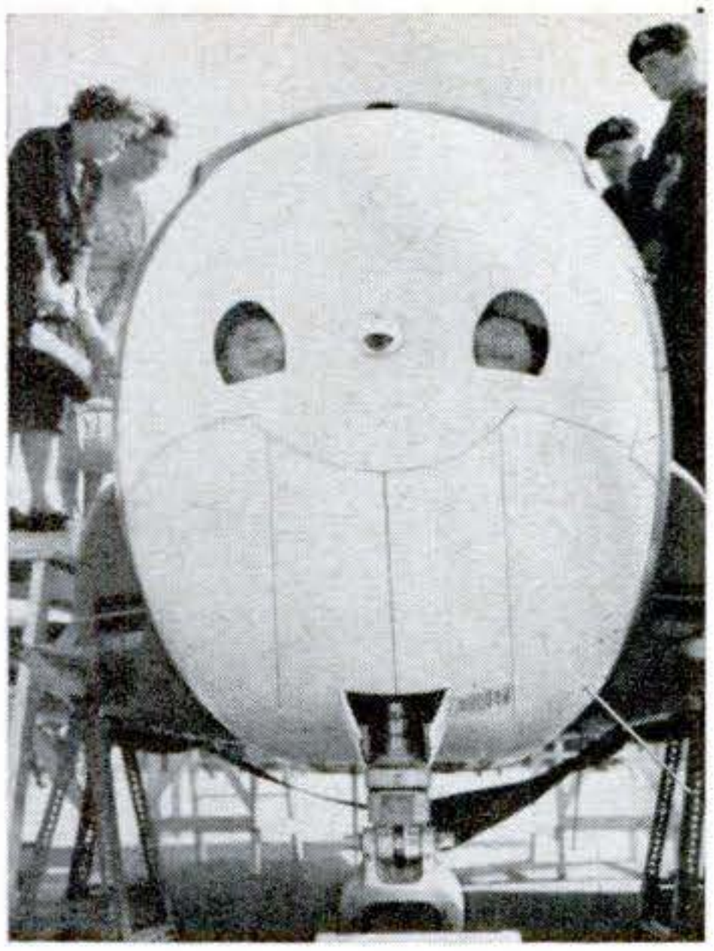
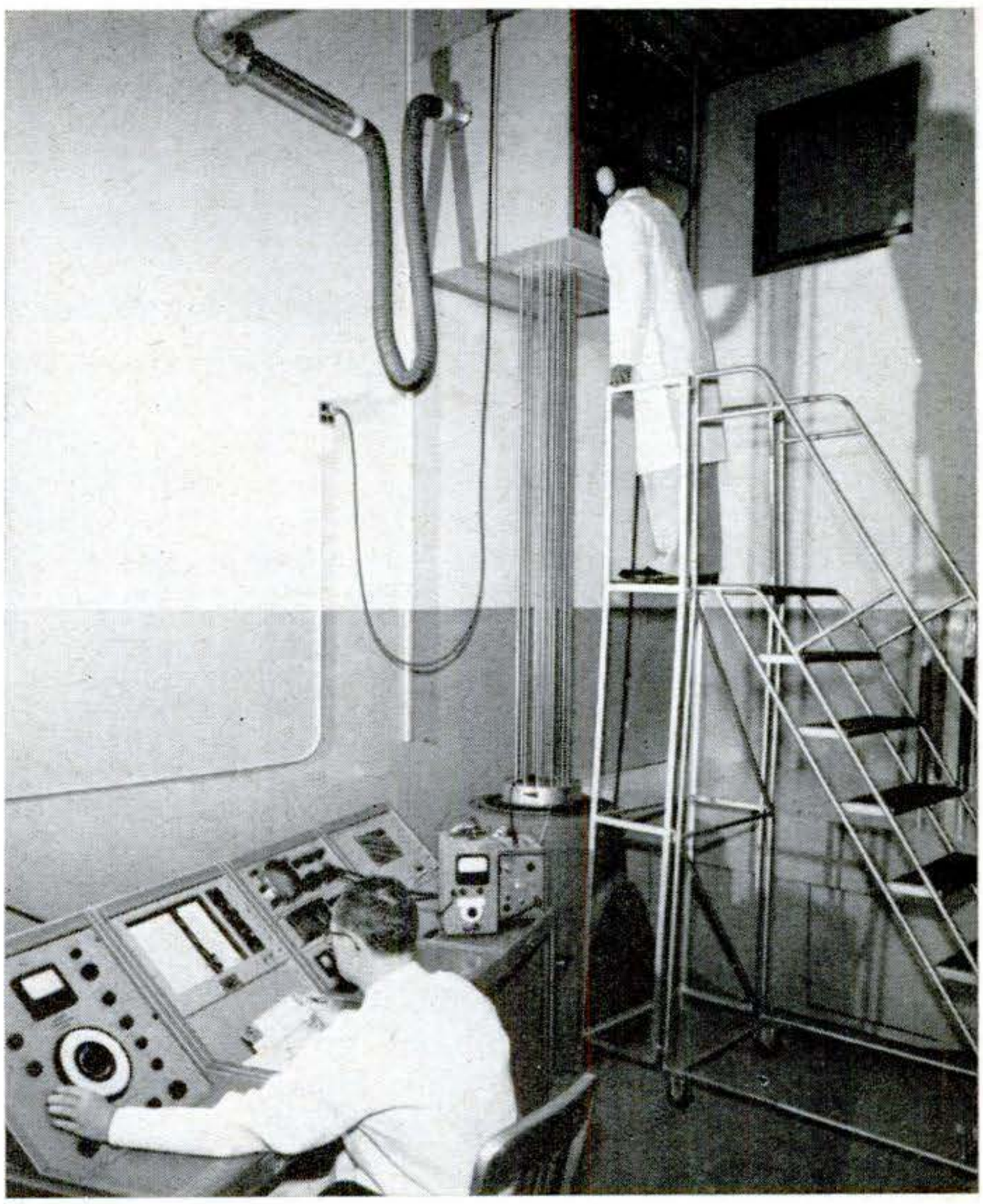


Flying face

Looking more like a cartoon character than a jet trainer, this Hunting Provost T. Mark 3 drew curious stares at the recent British Farnborough Air Show. Eye-like recesses in the two-seat primary and basic trainer house landing lights.

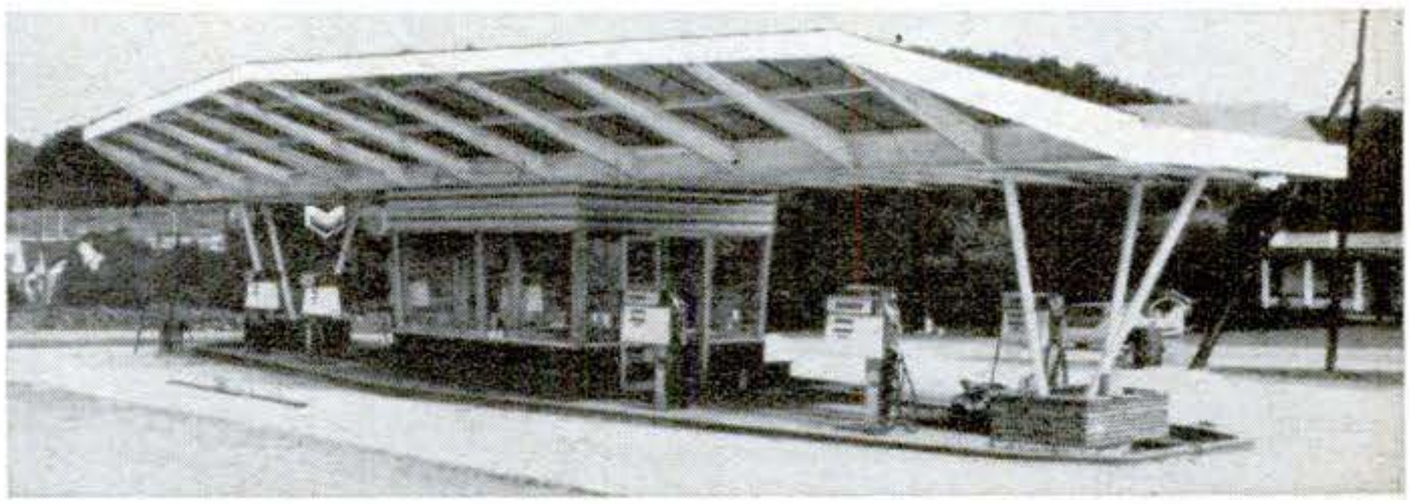
Scrambled talk

Here's a device that will thwart wire tappers and extension or switchboard eavesdroppers. It's a portable telephone scrambler that makes your conversation unintelligible to everyone but a person equipped with an identical unit. It's battery-operated, requires no connection; it's simply held against the receiver. Delcon Corp., Palo Alto, Calif., sells them in matched sets—at $219 a pair.



Super "hi-fi" packs atomic fuel

It's hardly music (notice the ear muffs on one technician), but very loud sound does a fast job of loading atomic fuel into pipe containers. A 24,000-watt amplifier —1,000 times more powerful than the average hi-fi rig's—drives a vibrator (bottom of the tubes) that jiggles the fuel powder down. The vibrator is built like a moving-coil loudspeaker, generating sound between five and five thousand cycles. GE is testing the idea at Hanford plutonium plant, Richland, Wash.



Portable service station

The filling station above was transported 120 miles on three trailers from Perth Amboy, N. J., where it was prefabricated, to Weissport, Pa., where it was erected on a Pennsylvania Turnpike interchange. If the owner ever wants to, he can take it apart and truck it to a new location. Petro-Portables are made by Continental Copper and Steel Industries.

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Riding the BMW...

Rolls-Royce of Motorcycles

It's not the speediest or biggest, or most powerful—but it's a joy to handle

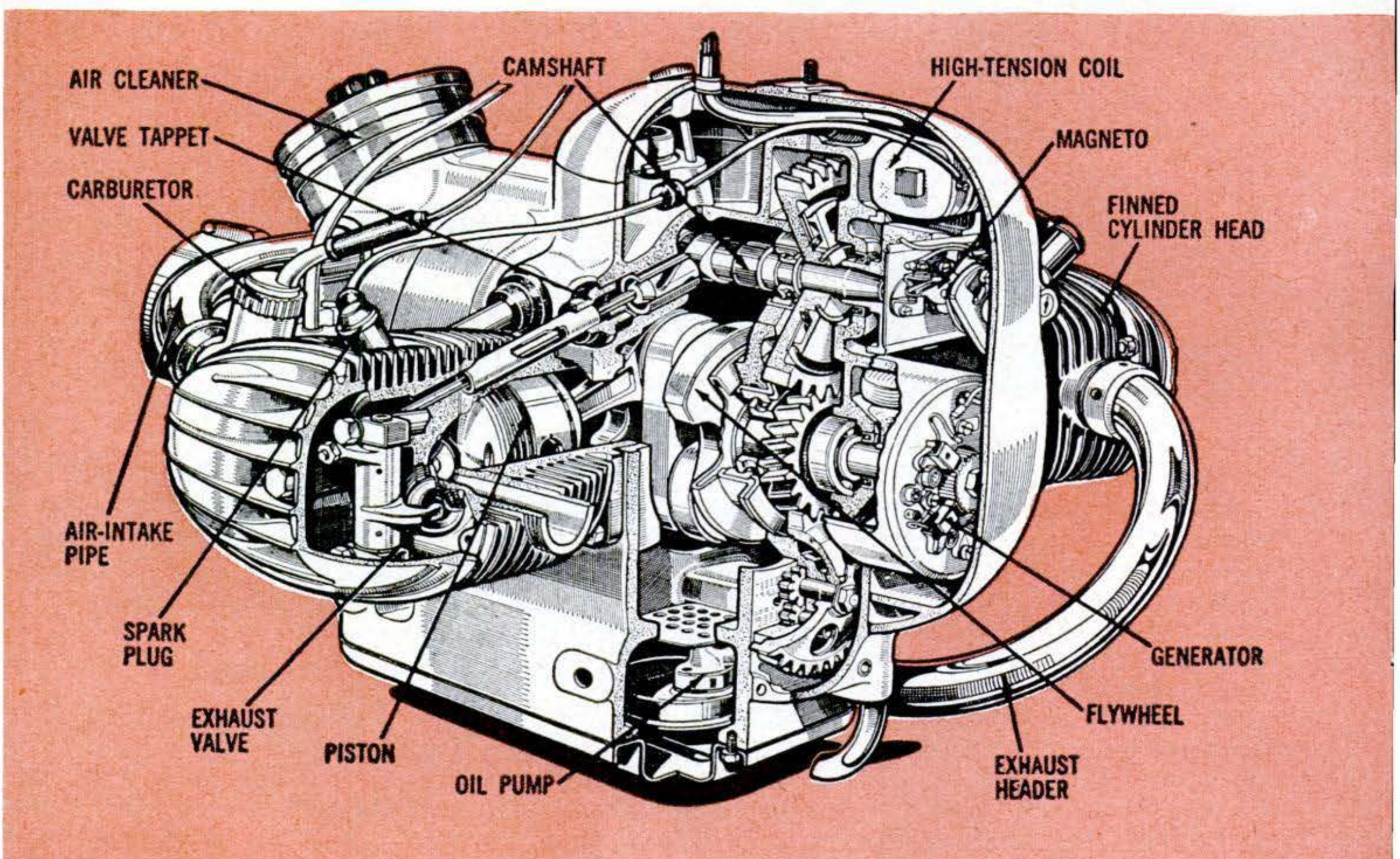
By Erik H. Arctander

THE highway knifed straight across a vast potato field. For half a mile ahead of me there were no side roads, no other vehicles, just two lanes of dead-level concrete. This would be the crucial test of the R-69 BMW, the Rolls-Royce of motorcycles.

Pulling the clutch lever in against the left handlebar, I pushed the gear-change pedal down into first with my left foot. As I let out the clutch and twisted the throttle on the right handlebar, the bike shot forward with a low-pitched growl. The speedometer needle swung briskly to 30, then leaped to 40 as the high-speed cam took effect. At 45 m.p.h., the engine r.p.m hit about 7,000. The clatter of valve float signaled that this was top speed in first.

I shifted up, the clutch took firm hold in second gear, and the bike lurched eagerly ahead. The engine kept winding up as though it would never peak. In seconds the speedo needle touched 65, yet there was no hint of strain, almost no noise audible over the steady rush of wind.

Valve float again interrupted the speedometer needle's rapid travel, so I flicked into third. Once more the engine climbed the r.p.m. scale with abandon. At 85 m.p.h., wind resistance (mostly



TWIN CYLINDERS are horizontally opposed. This lowers the center of gravity, improves the cooling, and supplies a safety guard. Engine and gearbox are enclosed in a single housing.

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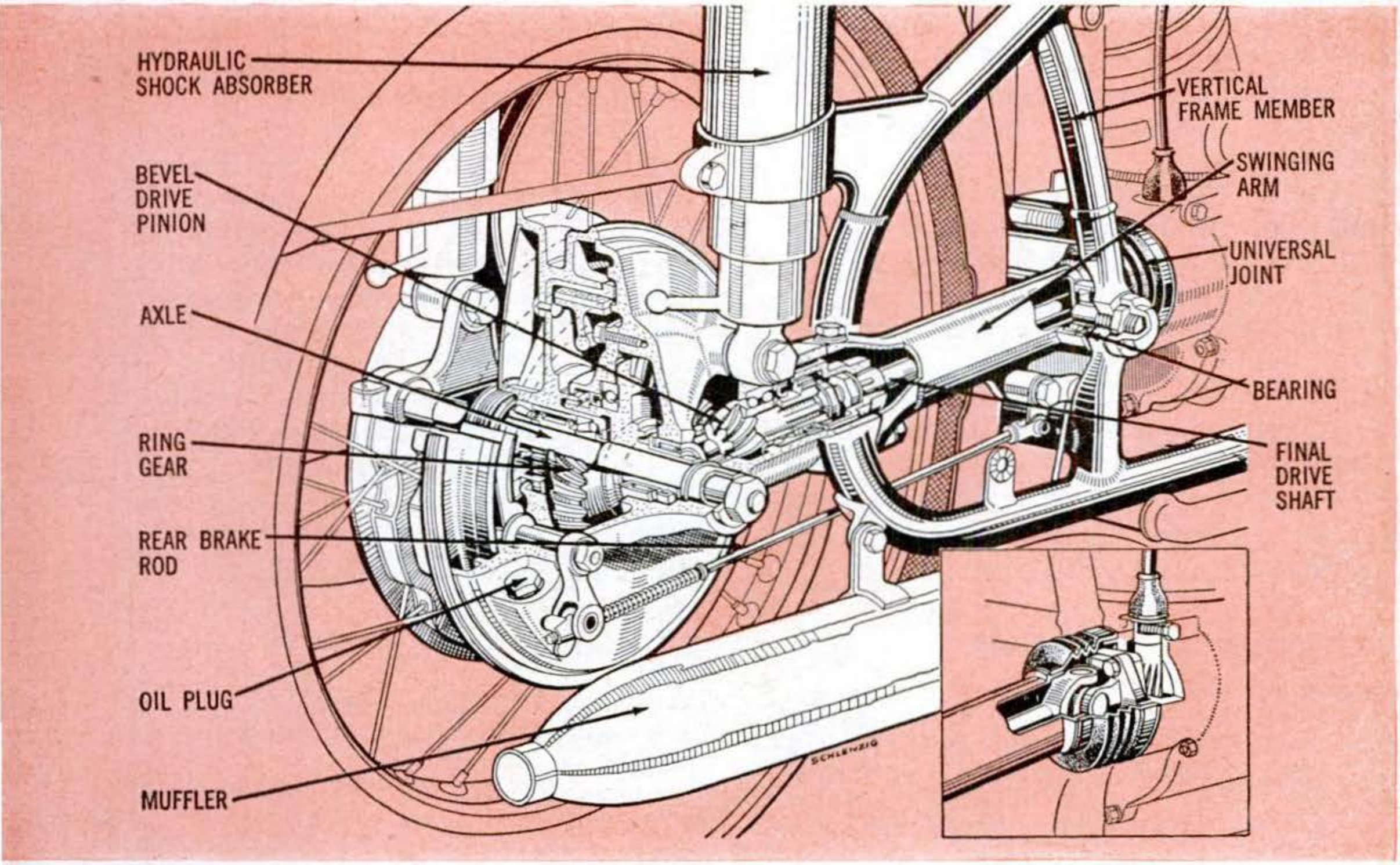
WHAT DO YOU WANT FOR $1,381? Quality. And that's just what you get in the German-made BMW R-69—from precision machining of all its parts to a truly elegant paint job.



A SHAFT DRIVE instead of the usual chain transmits power to the rear wheel. Cardan shaft passes through the hollow swinging arm on the right side. All gears run in oil bath.

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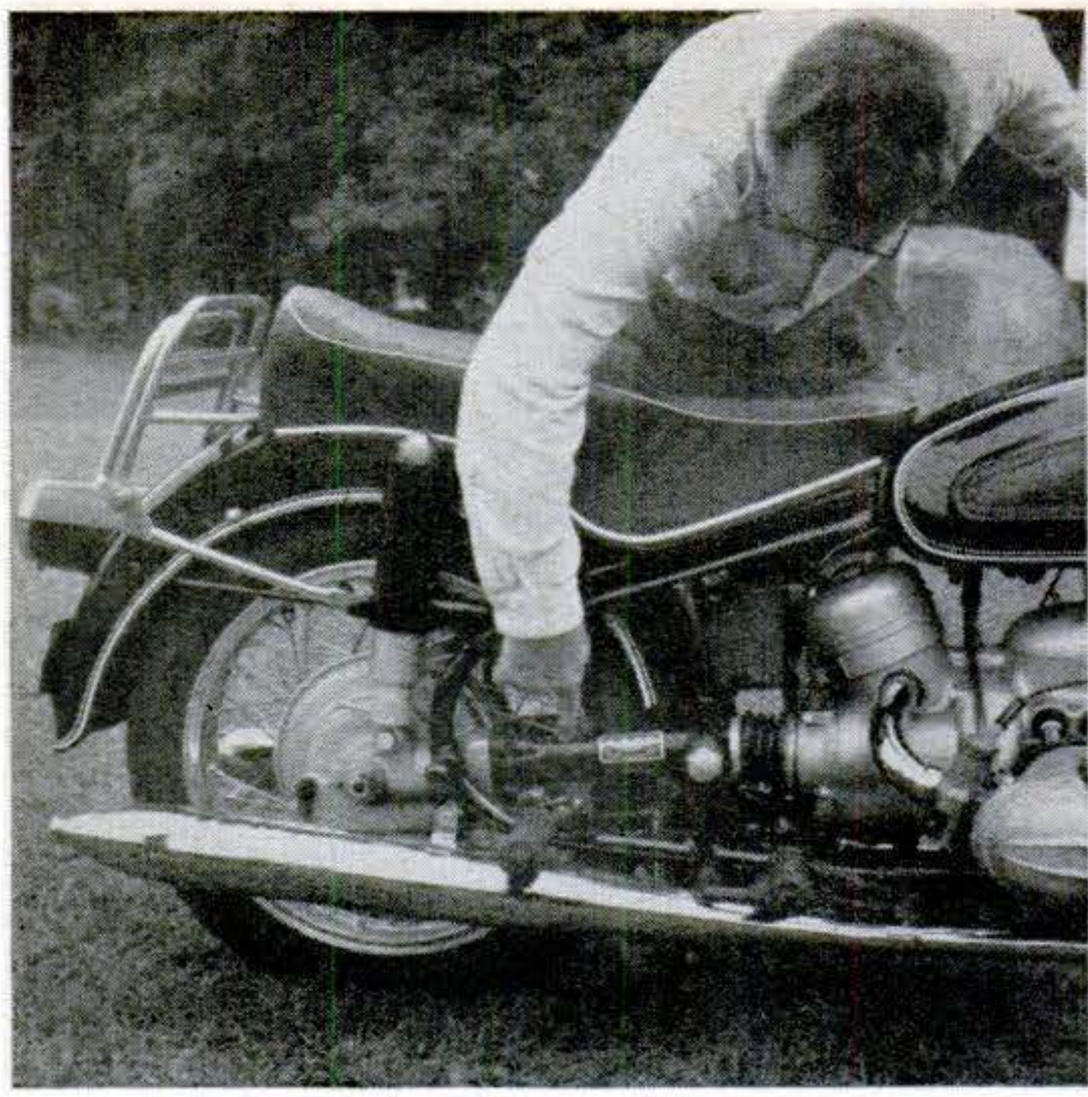
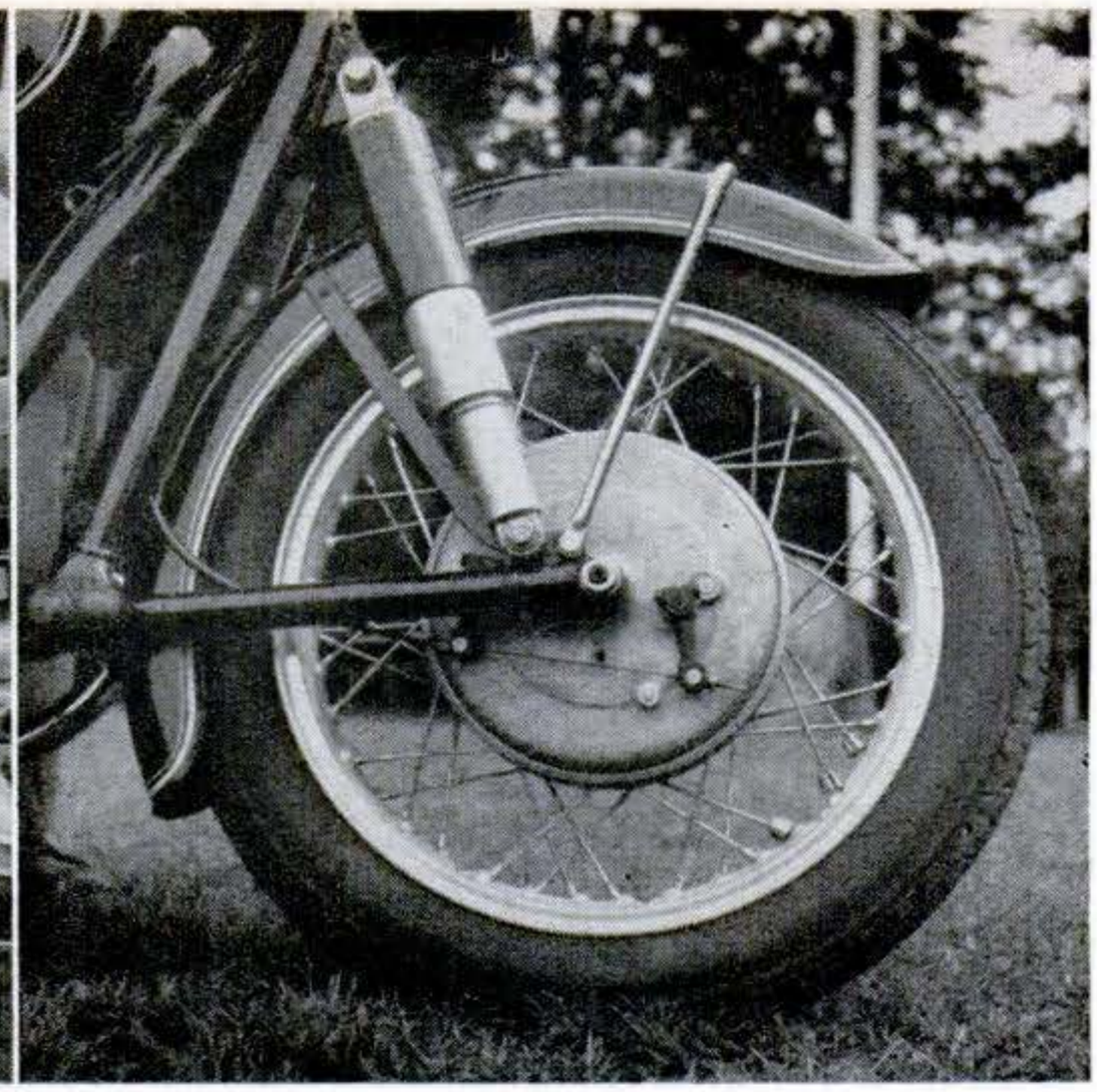


REAR WHEEL is suspended from two swinging arms pivoted on vertical frame members. Finger points to right arm. It also houses the drive shaft. Hydraulic shocks dampen wheel bounce.



UNIQUE FRONT SUSPENSION, designed in England by Earles, keeps the motorcycle's front end level, or makes it rise slightly under heavy braking. Front brake has twin leading shoes.

my unstreamlined body) was cutting acceleration drastically. Though there was no sign yet of valve float in third, I shifted into fourth gear, trying for top speed. In a final surge the needle hit 90 m.p.h. I could have waited a little longer or crouched over the tank to reduce wind resistance and thereby raised the top speed to 95 or 100. But the end of that half-mile was zooming up alarmingly ahead of me, so I backed off on the throttle.

When I had slowed to 75 m.p.h., I squeezed the front brake lever lightly with my right hand and pressed on the rear brake pedal with my right foot. Instantly the speed dropped as though a giant had laid hold of the rear fender. There was no shudder, no front-end dip, no uncertainty in steering, and no squeal. These binders were so powerful and smooth that I could only compare them to disk brakes on a $4,000 sports car. I made four more high-speed runs and each time was impressed with the motorcycle's rock-steady feel when booted along at high speed.

The BMW is truly a thoroughbred. It's not because she's the fastest thing on two wheels—there are some British-made Vincents still around that can top 140 m.p.h. in stock condition. Several other British machines are capable of 115 m.p.h. or better. And the big Harley-Davidson FLH, with 58 hp., can probably trim her handily in acceleration.

What makes this West German motorcycle remarkable is the same thing that makes the Rolls-Royce a standout among automobiles. The BMW is built to a high standard. It has earned a reputation for flexible performance, reliability, long life, safe handling, comfort, and

[Continued on page 230]

Specs on the BMW R-69

Engine: horizontally opposed twin-cylinder OHV; displacement, 590 cc.; 35 hp. at 6,800 r.p.m.; bore and stroke, 72 x 73 mm.; compression ratio, 8:1; gear ratios: first 4.17:1, second 2.725:1, third 1.94:1, fourth 1.54:1, final-drive ratio 3.18:1.

Performance: top speed, 103 m.p.h.; gas consumption, 60 m.p.g.

Suspension: hydraulic-damped swing frame with suspension units and hydraulic shock absorbers.

Dimensions: overall length, 82¾ in.; handlebar width, 28¾ in.; weight, 444 lb.

Price (f.o.b. N.Y.): $1,381.

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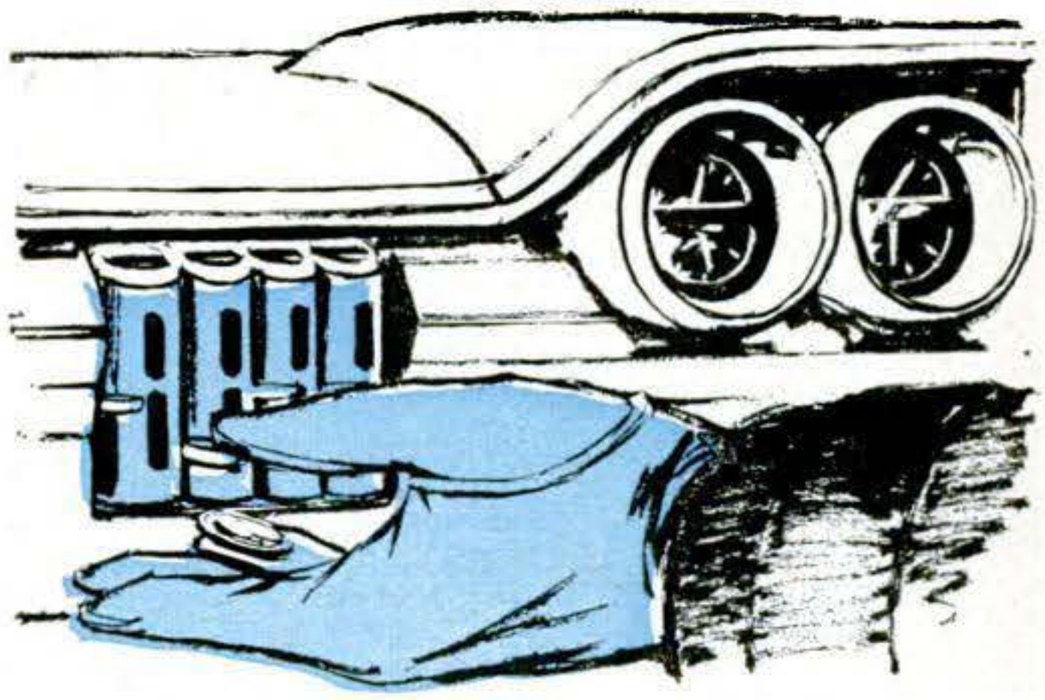
"I'd like to see them make..."

AIR-BREATHING VALVES on storm doors so they'd be easier to close. The valve would automatically bleed off air caught between the inner and outer door.—*M. Malmgren, Aurora, Ill.*

ZIP-UP ICE SKATES with laces, too—to adjust indoors. Outdoors, you'd just zip them on or off without freezing bare hands or fumbling with laces.—*J. J. Brill, St. Nazianz, Wis.*

STICK-ON ROLL FILM you'd press onto a take-up reel instead of fussing with a slot. There'd be an adhesive on the back of the first inch.—*A. R. Tanner Jr., Poughkeepsie, N. Y.*

THROWAWAY PERKING BAGS of flow-through fabric or paper. They'd hold premeasured coffee and eliminate cleaning that messy percolator basket.—*H. Lemunyon, N. Industry, Ohio.*



A CHANGE HOLDER on the car dash. Why not a smaller version of the bus-driver's change maker to deal out coins for parking and road tolls?—*Mrs. R. H. Fitzpatrick, Gary, Ind.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

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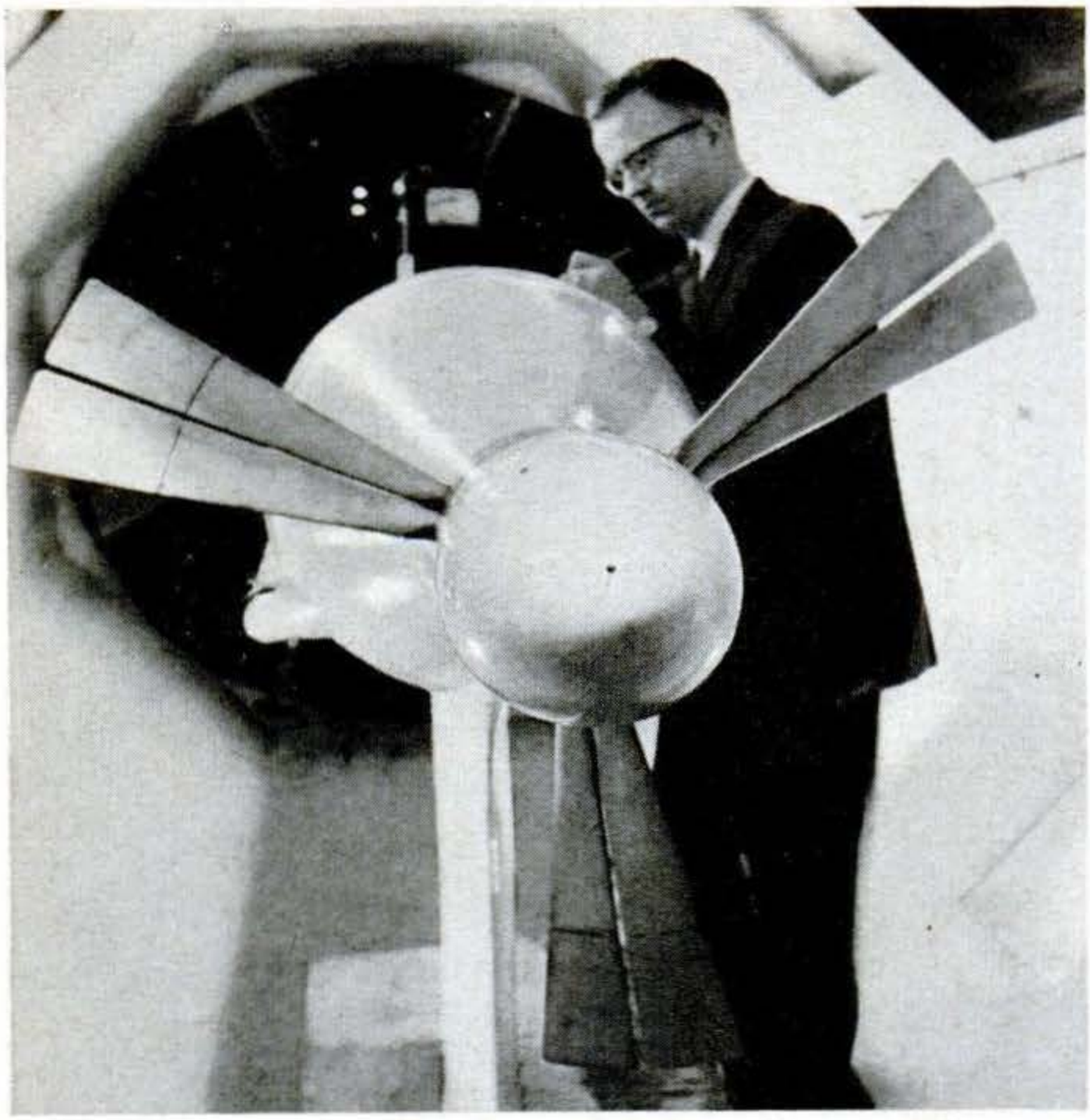
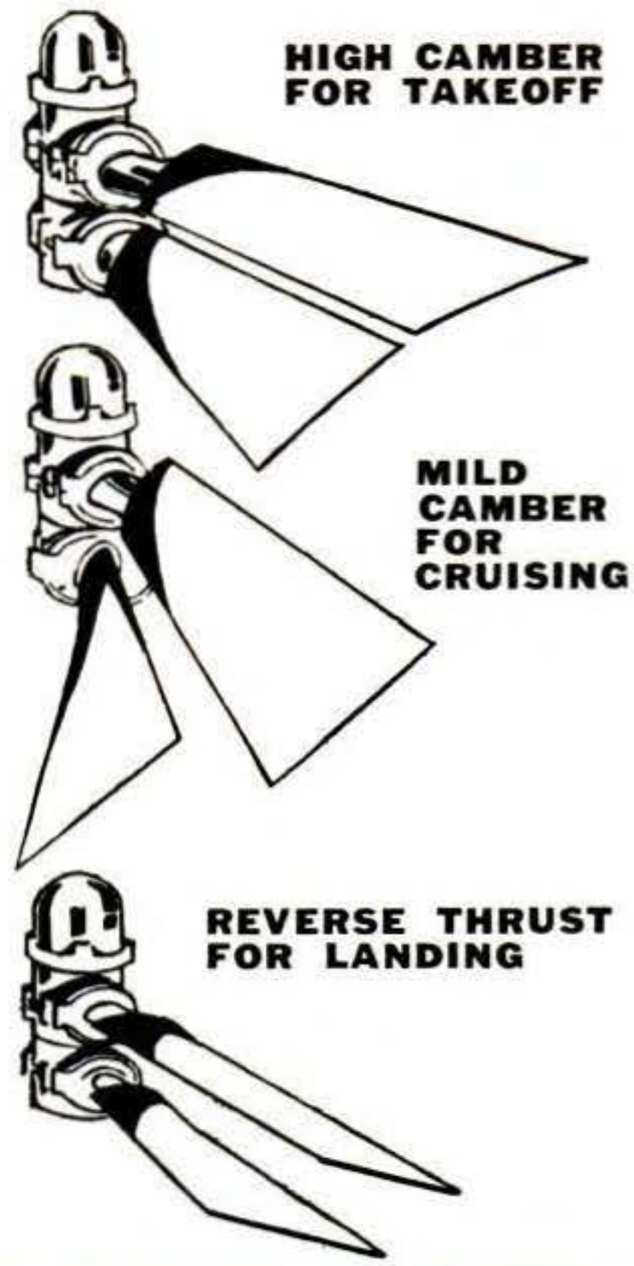


WIND-TUNNEL TESTS of scale model showed up to 35 percent increase in takeoff thrust, but no loss in cruising efficiency. A full-scale prototype should be built within half a year.



THE GREATER THE CAMBER, the more thrust at takeoff. An adjustable-camber propeller can be especially useful for vertical-takeoff-and-landing (VTOL) experimental aircraft.

Prop changes curvature in flight

Increased range, speed, and payload, as well as shorter takeoffs and landings, are the advantages of this variable-camber propeller, the first of its kind for aircraft use. Six blades are mounted in staggered pairs on a hub. Changing the angle at which each pair meets alters the camber, or surface curvature, thus varying thrust according to flight conditions. Hamilton Standard Division of United Aircraft Corp. developed the propeller under Navy contract.

Heat rays count cars in traffic

The double-barreled black box at left uses invisible infrared rays to count every car that goes by (to regulate stop lights or survey traffic). It tallies the cars as they interrupt its down-shining beam, which the roadway reflects. Minneapolis-Honeywell says it's better than similar radar-actuated counters because it doesn't require precise aiming and can be hung on any light pole or building. Passing motorists won't feel the heat rays.

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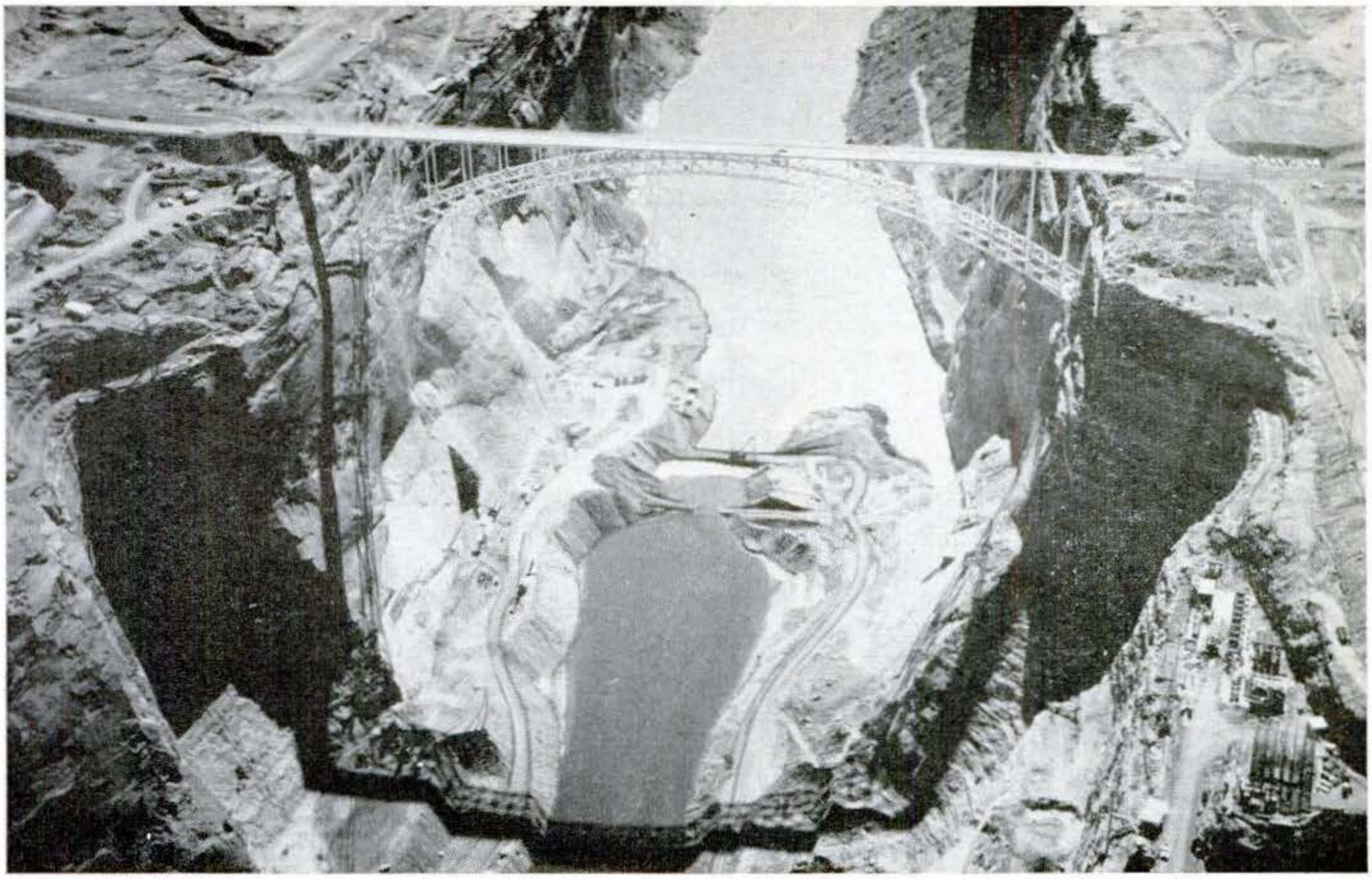
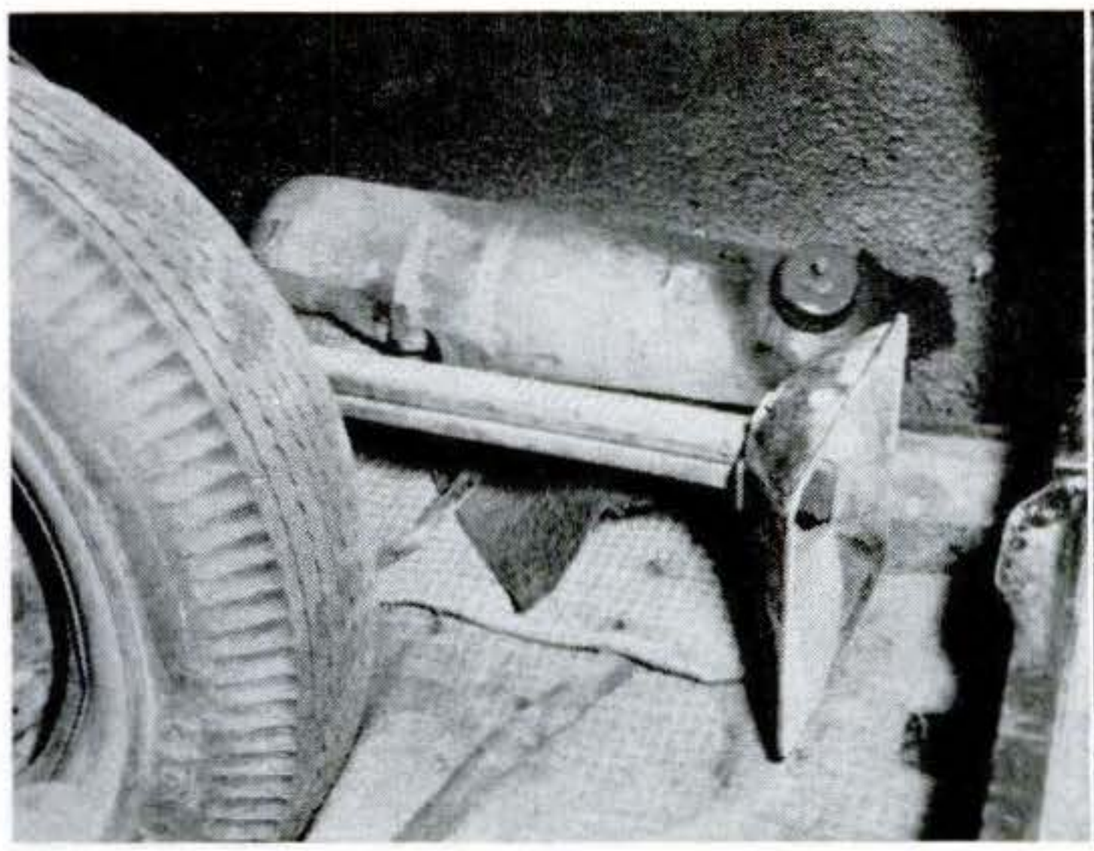
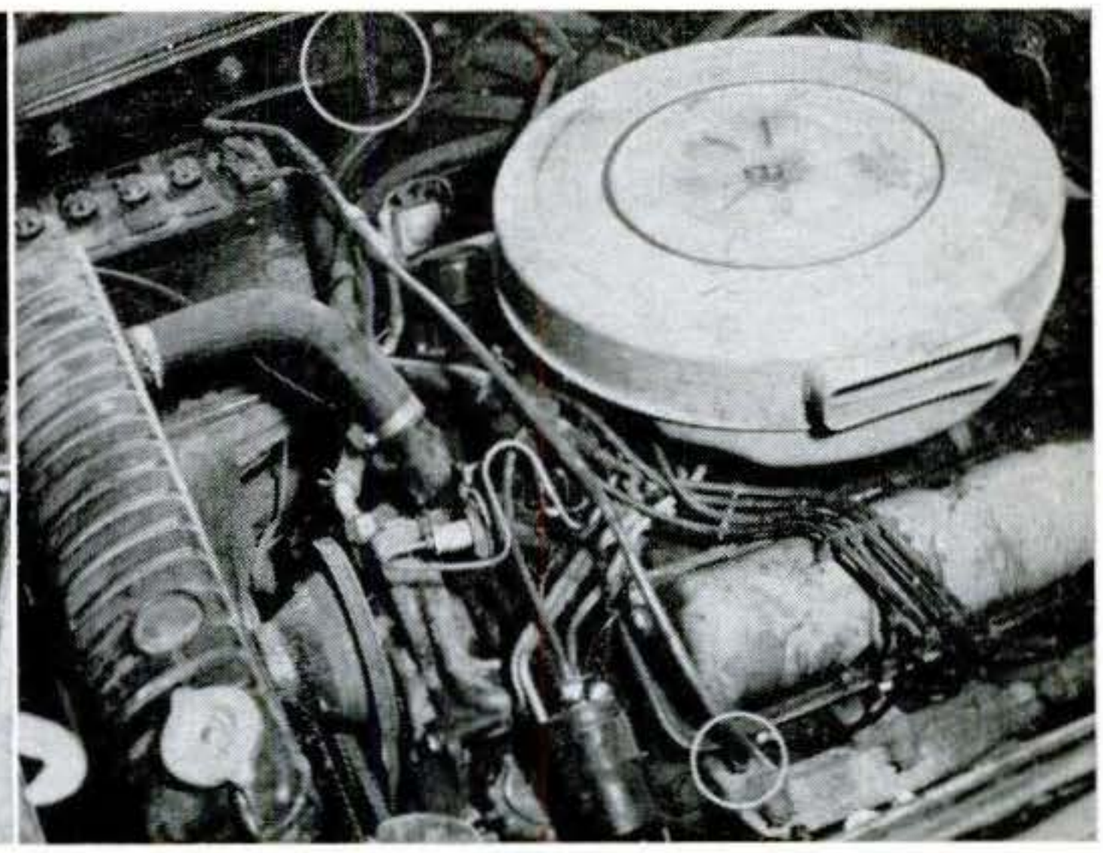


Most beautiful bridge in the country

This dramatic bridge casting its shadow over the bottom of a gorge has been named the most beautiful in its class—with a span 400 feet or greater—opened to traffic last year. It's the Glen Canyon Bridge at Page, Ariz. A jury of architects and engineers representing the American Institute of Steel Construction called it an "elegant, airy arch design that contrasts with the grand brutality of the setting." It was built with a minimum of disturbance to the landscape.



KEROSENE TANK is kept under compression by air from spare tire. A tube connects them.



SMOKE-MAKING LIQUID flows from valve (upper circle) to exhaust manifold (below).

Crook tries smoke screen

This 1959 car was rigged up by a jewel thief to throw out a smoke screen in case he was pursued by the police. He installed a tank in the trunk holding a mixture of kerosene and oil under pressure from compressed air in the spare tire. It was connected by tubing to the exhaust manifolds and controlled by a valve on the dash. When the mixture hit the hot manifolds, a black smoke resulted, which issued from the exhaust. He also rigged a switch to cut off rear and brake lights. The thief was caught by the FBI—but apparently not in a chase.

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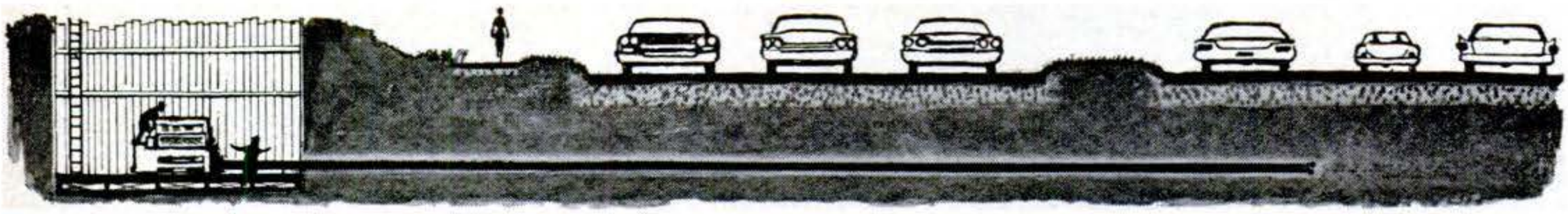
Mechanical Mole Tunnels Under Traffic



A MAMMOTH mechanical mole is burrowing under city streets these days. The mole, a 14-ton diesel-driven machine, bores horizontal holes through the earth for heavy-duty gas mains and electric-cable sleeves. It beats trench digging: Only a third as much earth need be moved; and overhead, traffic rides undisturbed.

The mole works like an oil-drilling rig gone berserk: It bores sideways instead of straight down. It even borrows an oil bit for its drill head—a tri-cone cutter so tough it can pulverize solid rock.

Powering the unit is a 150-hp. diesel. This connects to a torque converter, which in turn feeds into a 30:1 reduction gearbox. The last gear turns a splined shaft that drives the boring pipe. With the engine at 1,800 r.p.m. the torque converter's output ranges between 410 and 310, and the final drive is between 13 and 10 r.p.m. You can count every powerful revolution.

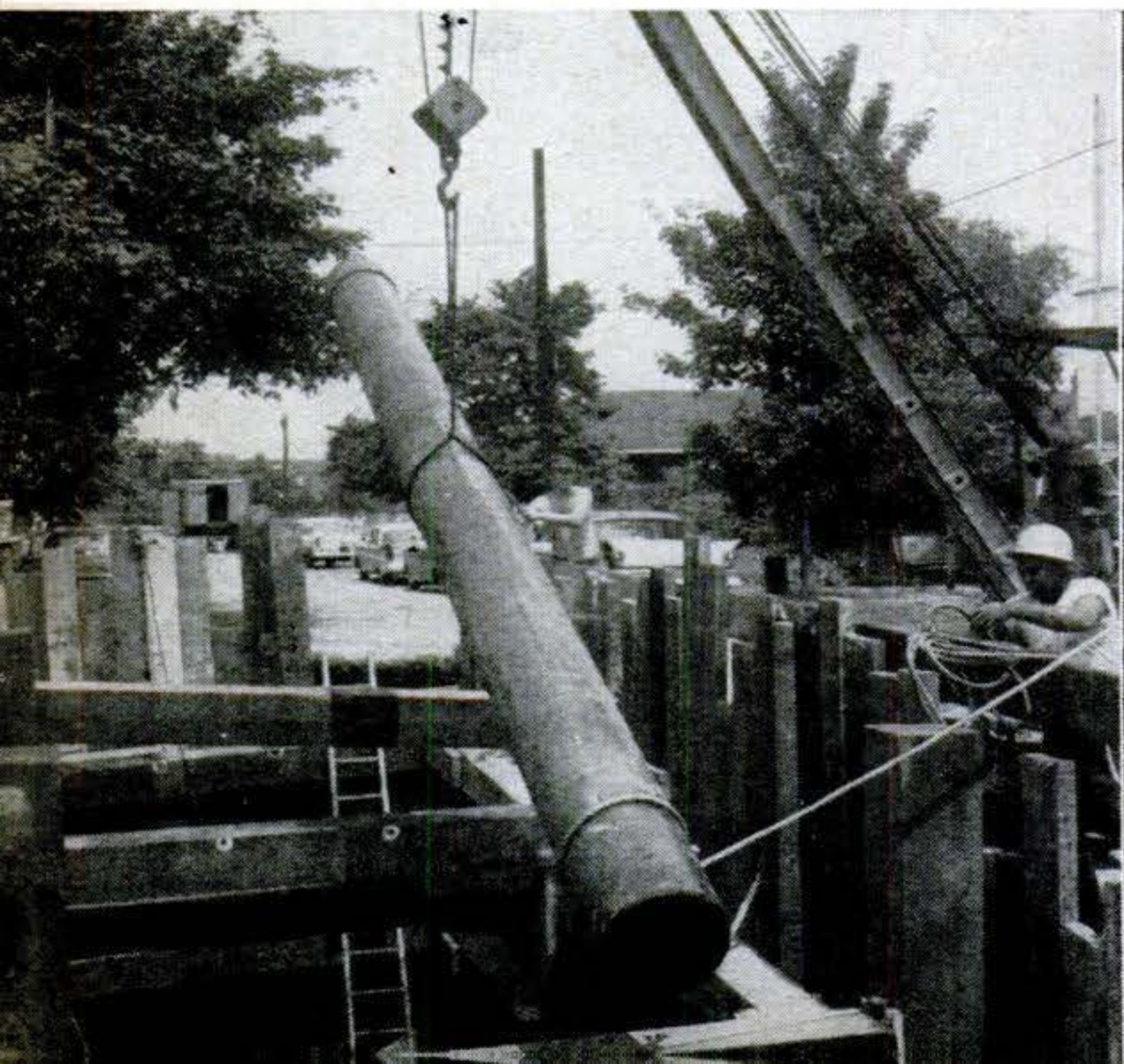
The machine, one of several developed by Boring, Inc., of New York, rides on steel I-beam tracks 36 feet long. These line the bottom of a trench on one side of the road.

A deft touch. Operating the mole is no easy trick. We watched Bill Cetin, foreman of a seven-man crew, one afternoon as he prepared to put in the next 20 feet of an oiled static—a 16-inch steel pipe with walls a half-inch thick. In use, it would be filled with oil to insulate a high-voltage cable connecting two substations of New York's Consolidated Edison company. The tunnel, 270 feet long, would run under Astoria Boulevard, an eight-lane artery leading toward Manhattan.

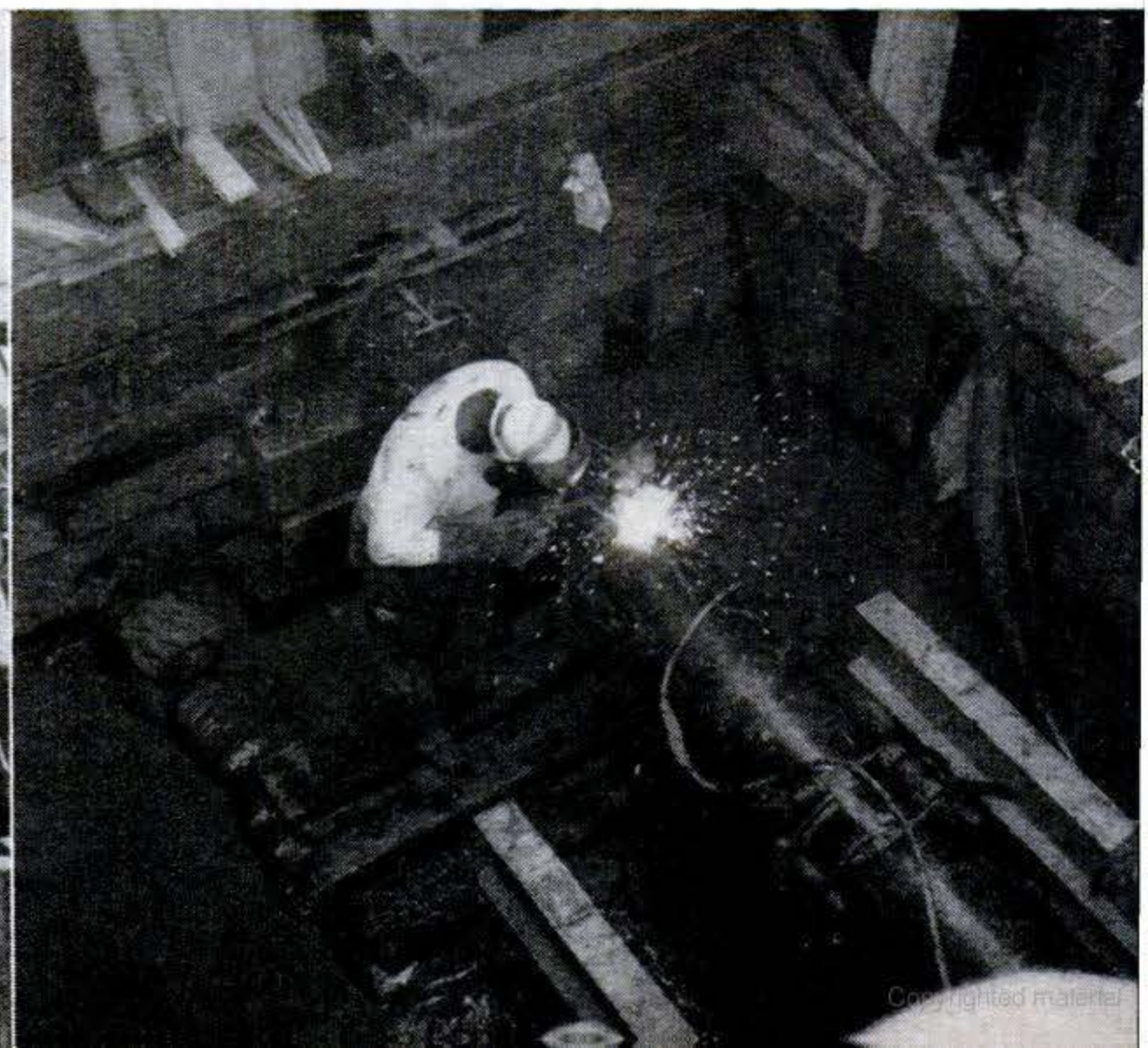
The new length of pipe had been gentled into place by an overhead crane. After it had been threaded through the network of pilings it was fitted into the bonnet of the machine, aligned, and welded to the preceding length of pipe.

Inside the pipe was a thin tube that would carry Aquajel—a slurry that would be pumped in to mix with the soil and

1 THREADING OPERATION: Held by a crane, a 20-foot length of pipe is fed through pilings and into pit, where it will be aligned with previous section of pipe in boring machine.



2 WELDING IT ON: Welder attaches a new length of pipe to the old. At the other end of the new piece, he'll burn out a hole to let slurry mixed with digging debris pour out.



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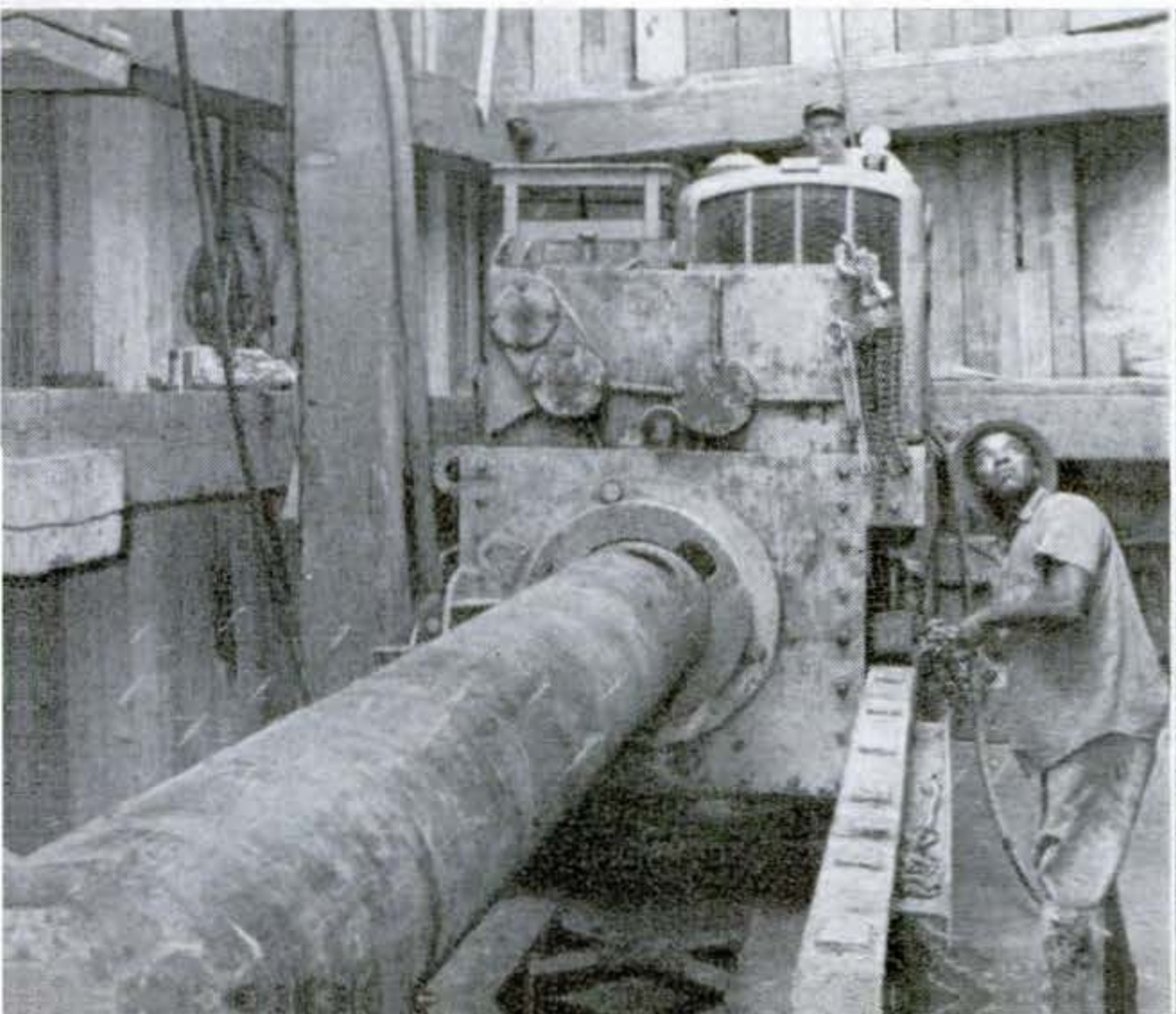
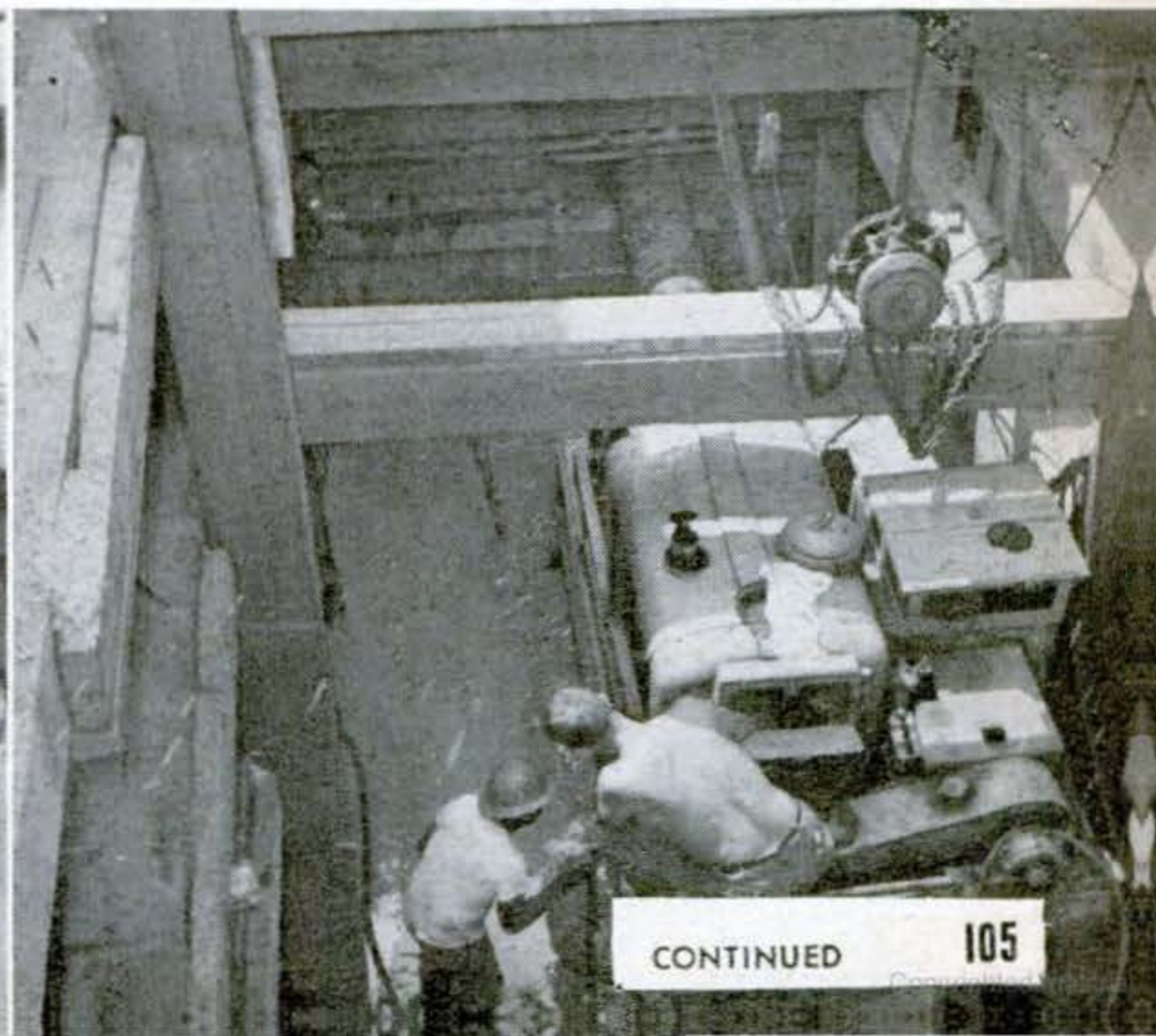
MASSIVE BORING HEAD can chew through solid rock. The tungsten-carbide bit is similar to the ones used in oil drilling. It cuts to a diameter two inches larger than the pipe.

3 THE MOLE IS PULLED BACK to the end of its 36-foot track and gets set to bore. Controlled by a pair of hydraulic jacks, it creeps forward in 20-inch steps.



4 "HOW FAR THAT TIME?" Foreman Cetin cuts the throttle and checks the pipe's advance with a workman. Hip boots are standard for moving around the slurry-filled pit.



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5 COMING THROUGH at the end of a bore is a happy moment for drillers. The pipe, all but covered by slurry, emerges in the much smaller receiving pit 270 feet away.

6 HOISTED BY CRANE, the six-foot boring head is lifted out of the receiving pit after a welder has burned it off the pipe end. Cetin starts the preliminary scraping job.

7 GOOD TOOLS, GOOD WORKMEN: Workers clean and rinse the drill for the next job.

rock chips, and float them back to the entrance. It also would leak out through the cutting head between the earth and the pipe to lubricate it—vitally important when boring is under way and friction mounts.

Ready to go. When the weld was completed, Cetin perched on the crossbar behind the engine. It was hot, painstaking work and Cetin, stripped to the waist, would be angled at 45 degrees most of the time to watch the pipe's progress. He checked the pipe's alignment once more and then revved up the engine. Blue exhaust fumed up and when the diesel was humming he engaged the drive shaft. The pipe began to cut its way in. It was like going through butter. The pipe turned about 11 r.p.m. and progressed a foot every five minutes.

Outside in a trailer, Louis Straussl watched the sump pump. His was the equally important job of regulating the flow of Aquajel, checking the shakers that would reprocess it, and pumping it through again. If not enough was getting through, the drill head could burn out.

Hazards. There were other dangers, too. The worst would be if the machine jammed against something solid while at top speed. Then the tremendous torque action of the pipe might reverse itself and set the machine in St. Vitus' dance shakings—conceivably even turning it over. Operators needed almost a sixth sense to know what was out there.

We wondered, what about cutting into high-voltage lines? Bill Cetin grinned. "That was the first question I asked when I started to work these things three years ago. Tracks and machine are both grounded, so there's no danger." (In this case the bore was 12 feet down, out of the way of existing lines.)

The unforeseen. But sometimes, as on this job, one of those nobody's-to-blame flukes happens. Instead of coming out in the receiving pit, the pipe didn't show. In the last 50 feet or so the mole had struck something viciously hard. It started to vibrate, then painfully crawled the next 20 or 25 feet. But the pipe had angled off course. Rather than waste time looking for it then, a second boring was made. This time the pipe homed in perfectly. As is the case in the 20,000 feet of pipe Boring puts underground every year.—*Joan Steen.*

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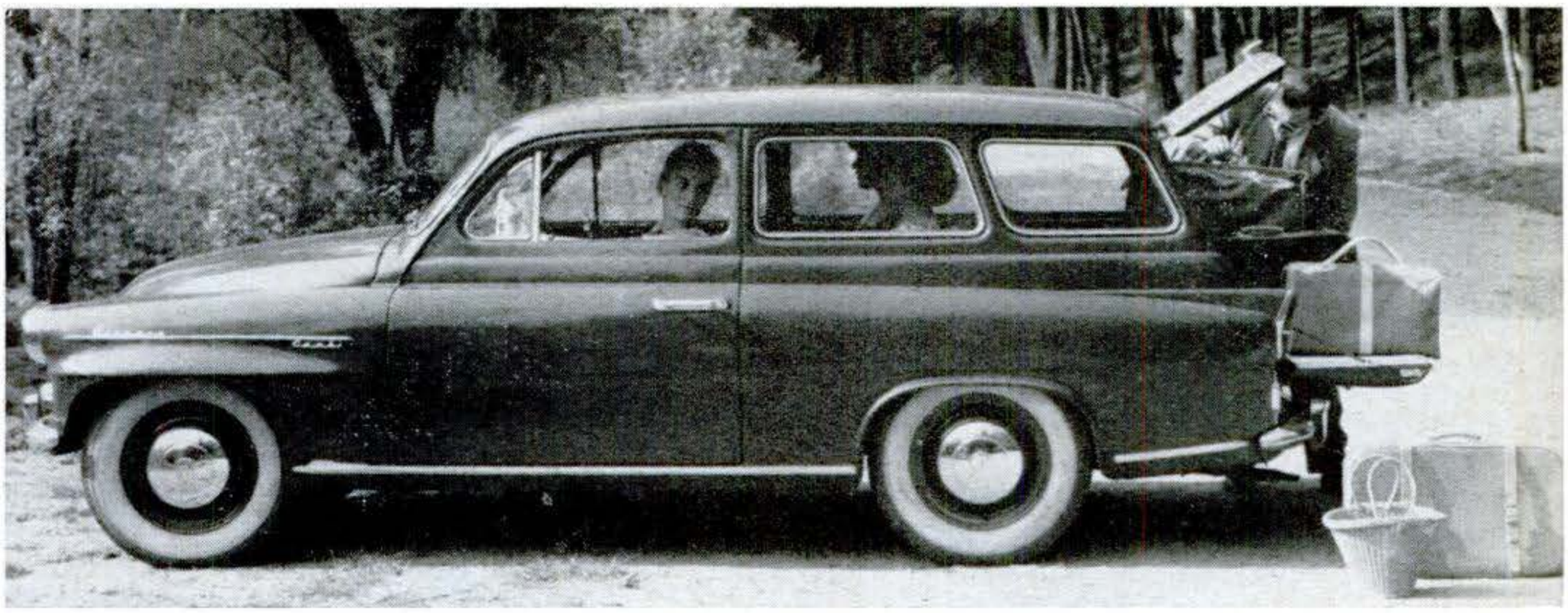
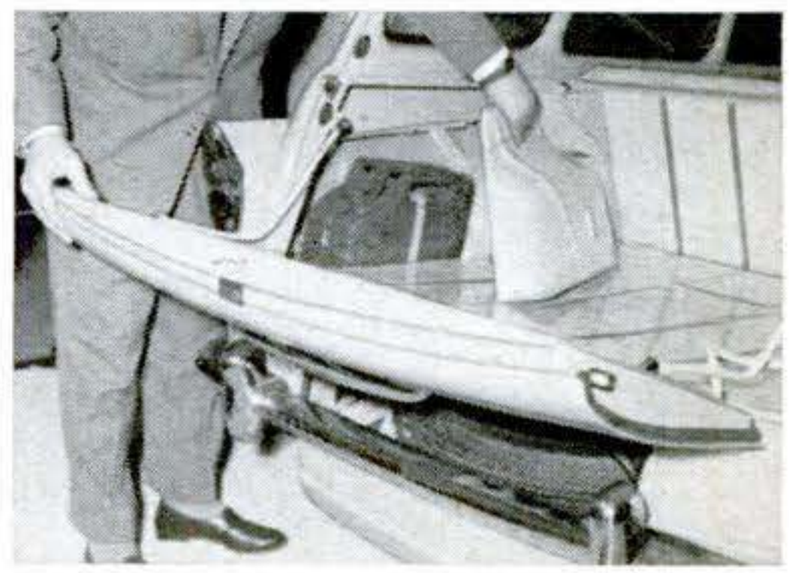


Octavia Combi wagon, shown being loaded, has 1,221-cc. engine, tubular backbone frame.

Latest Czech station wagon

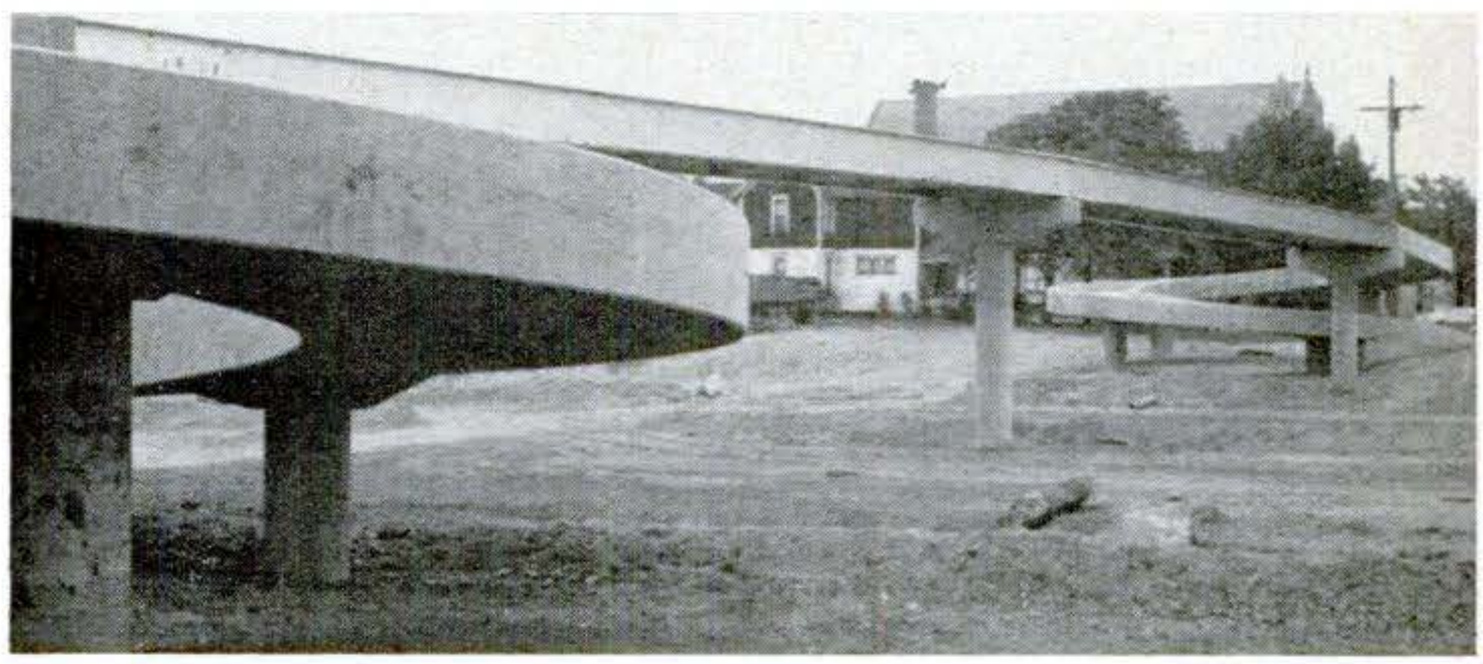
No need to remove luggage from the new Skoda station wagon to get at the spare wheel and tools, thanks to a separate under-floor compartment. A storage cranny for a gas can or other items in the left tail fin is accessible via a removable interior panel. The car is made in Prague, Czechoslovakia.



SPARE-WHEEL PANEL drops on swinging arms when released by internal pull cord. Gas can is held securely by a strap.

Footbridge has no steps

This little concrete bridge will let pedestrians cross in safety when the new expressway is opened at Akron, Ohio. It has spiral ramps at the ends instead of steps to make it easy for bicycles and baby-carriages to cross.



Double-duty pod

Increased range and speed are provided for the Air Force's B-58 Hustler bomber by a streamlined twin pod developed by Convair. Lower portion, which carries extra fuel, can be ejected when empty. The Mach 2 bomber then flies to target, where it drops the upper portion of the pod carrying the nuclear payload. The twin pod replaces the old-style single one mounted beneath B-58 at left.

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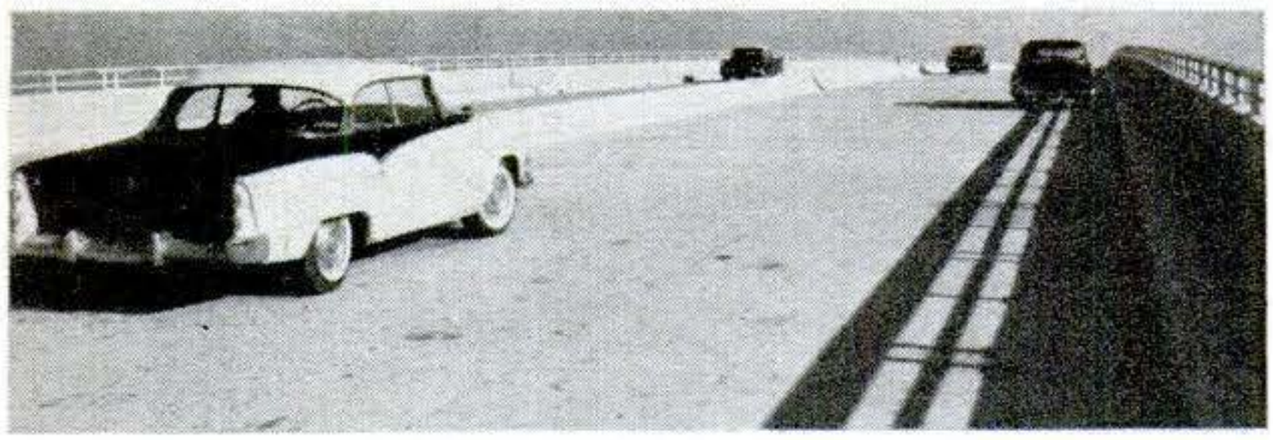
Chrysler 300-G makes debut

Chrysler's latest 300-Series model has been face-lifted with new grille, headlights, tail lights, and 15-inch wheels. The standard model has 375 hp. A rugged three-speed manual transmission is available at extra cost with a 400-hp. engine. Base prices start at about $6,000 for the four-seat hardtop with automatic transmission.

Fluorescent bridge

A total of 768 slender fluorescent tubes, each 42 inches long, gives a daylight glow to the roadway of this modern four-lane bridge at the entrance to the Barnegat Bay vacation area on New Jersey's Atlantic coast. The tubes are concealed in the aluminum rails 50 inches above the road's surface. They are shielded to throw light horizontally across the 56-foot expanse of pavement.

The 2,400-foot Manahawkin Bay Bridge is 30 miles north of Atlantic City. State highway officials are planning to have GE light other bridges with similar fluorescent railings.

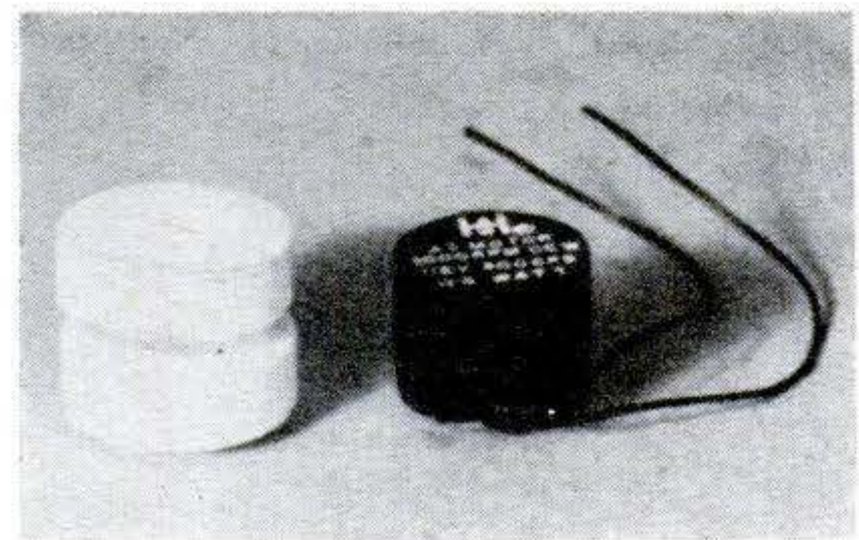


Easy to ride across in daylight . . .

. . . still easier at night—no shadows.

Camera traps burglar

A camera that takes pictures of criminals at work is the latest weapon of the San Angelo, Tex., police department. A tavern whose cigarette machine constantly was being burglarized was booby-trapped with a hidden camera, light, and alarm. A string fastened to the door of the vending machine set off the trap. The photo above enabled police to arrest the baffled burglar.



Pill-size motor

This 115-volt, 400-cycle single-phase motor is hardly larger than an aspirin tablet—smaller than two. It was developed by A. W. Haydon Co., Waterbury, Conn., to power microminiature timers used in industrial and military computers. The tiny motor is 3/8 inch in diameter, 9/32 inches high, weighs 1/9 ounce. It consumes less than a half-watt of current.

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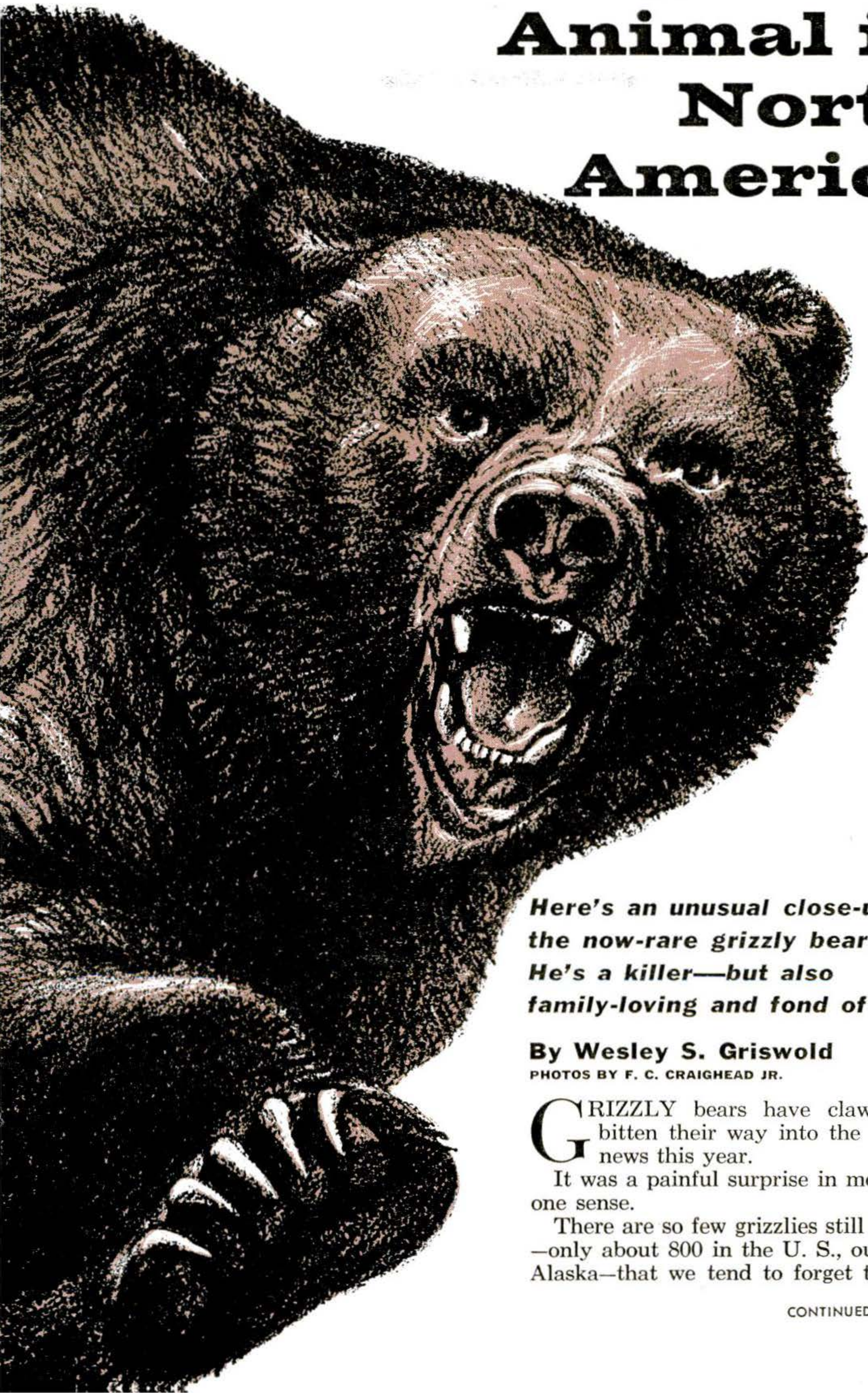
Most Dangerous Animal in North America



Here's an unusual close-up of the now-rare grizzly bear. He's a killer—but also family-loving and fond of fun

By Wesley S. Griswold

PHOTOS BY F. C. CRAIGHEAD JR.

GRIZZLY bears have clawed and bitten their way into the nation's news this year.

It was a painful surprise in more than one sense.

There are so few grizzlies still at large —only about 800 in the U. S., outside of Alaska—that we tend to forget that this

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The grizzly turns murderer in an instant if aroused . . . He

bear is the most dangerous wild animal in North America.

"The grizzly is potentially as dangerous as a tiger or a lion," says Robert N. McIntyre, chief naturalist of Yellowstone National Park.

Excepting Alaska, where until recently there were more bears than people, grizzlies are found in only five states: Montana, Colorado, Idaho, Wyoming, and Washington. Half of all the grizzlies outside Alaska are believed to live in Montana.

Dangerous encounters. Meetings between grizzlies and men, these days, are rare and usually accidental. But last summer, in Glacier National Park, four persons blundered into the beasts. They were savagely bitten or mauled. None of them died.

They were lucky. A mature grizzly can break the neck of a moose with one swipe of his iron-muscled paw. David de L. Condon, a naturalist who studied the bears in Yellowstone Park for 25 years, saw one do just that.

The grizzly can absorb bullets like a sandbag. As a boy, Robert McIntyre helped his father kill a grizzly that had been raiding colts on their ranch in northern Idaho.

"We had both killed black bears with

Why the grizzly is the king of American beasts

A mature male grizzly bear weighs 500-800 pounds and is as fast as a horse. In a headlong run, he has been clocked at more than 30 m.p.h.

When he rises on his hind legs, as he often does for a curious or lordly look around, he stands six to eight feet tall.

His canine-like jaws are lined with strong, sharp teeth and are powerful enough to snap the spine of a deer in one crunch.

His reach is more than in keeping with his height. His forepaws are at least a third longer and wider than an average man's hands, and are tipped with tough, narrow claws two to three inches long.

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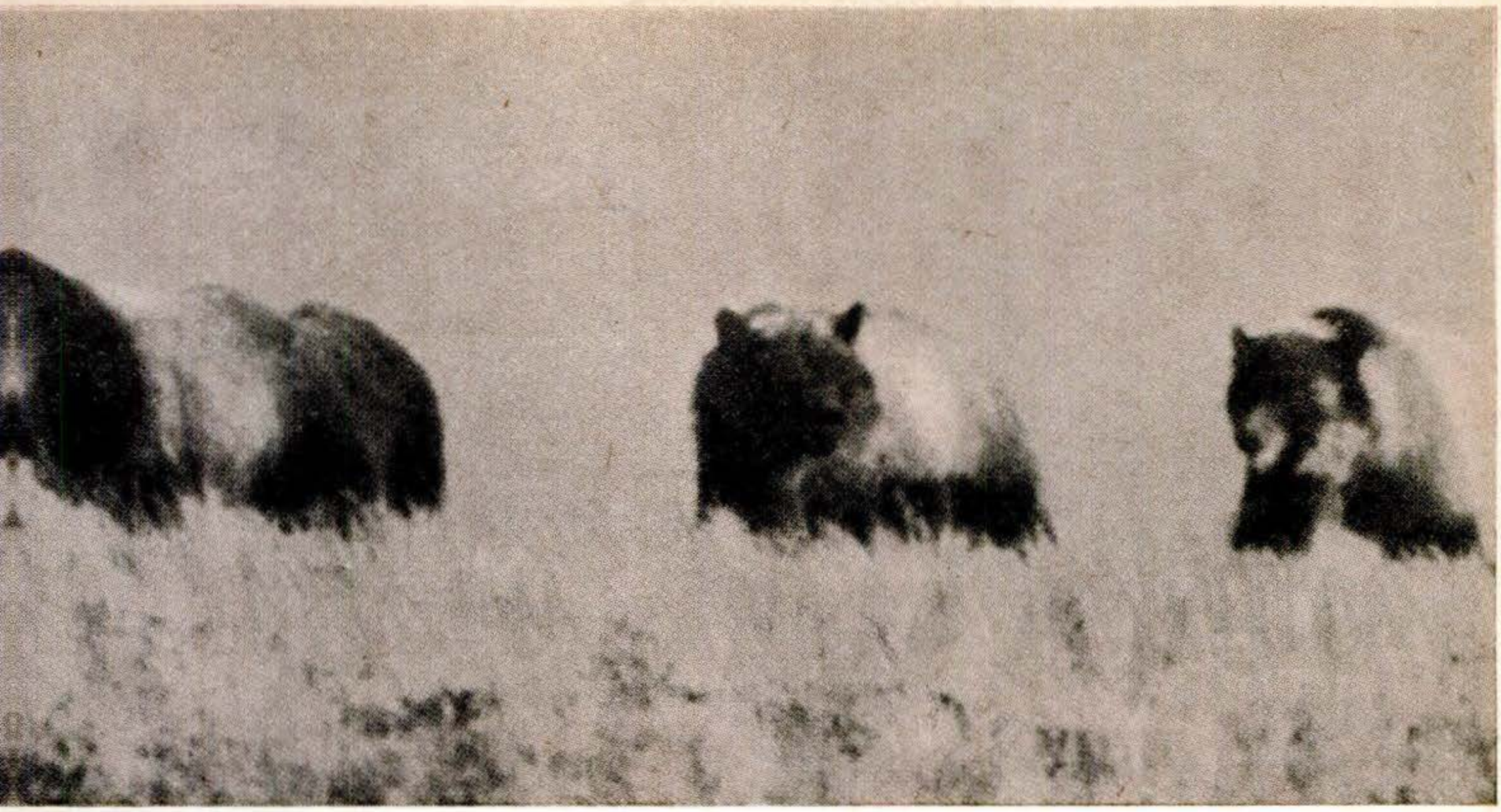

is potentially as dangerous as a tiger or a lion

a single shot," he recalls. "It took *nine* for the two of us to get that grizzly. And from where he was first hit, he ran at least 450 feet, breaking through a strong fence on the way."

Grizzlies now roam in considerable numbers only in Yellowstone and Glacier Parks. Each has more than 100 of them. Here they are protected from marauding men and, at the same time, are segregated as much as possible from people who might make the perilous mistake of trying to feed or pet them.

When grizzlies meet. As a member of an official party, one recent evening, I sat in a car in Yellowstone and watched a group of grizzlies—I counted 64—gather to feed.

As the sun slid toward the distant lodgepole pines, and the pines' deep shadows stretched slowly southeastward, the bears came from all directions.

Some arrived alone at a gallop. We often first spotted them by the little puffs of dust that exploded from the sagebrush as they came pounding in across the mountain pastures. Some dawdled—mothers lagging to let their two or three cubs keep up.

We knew they were grizzlies, all right. They all had that wide ridge of hair that looks like a hump on their shoulders. But their coats varied in color: black with

A BIG BRUISER that could kill a man with one swat shows his tongue as he begins to recover from a muscle-paralyzing drug. The man has just finished attaching ear tags so that the bear's movements through the wilds may be traced—part of an intensive study now under way to preserve the dwindling grizzly population.

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TAGGED CUB, reviving from drug, wears color-coded plastic strips in ears to provide lasting clues to age and rate of growth.

frosty-looking hair tips, cinnamon, dark brown.

One brute with a back as broad as a prize bull's reared up for a look-see. We estimated that he was between seven and eight feet tall and easily weighed 700 pounds.

There was hardly a sound at first but the rhythmic chuff of rough tongues. But as the crowd thickened, amiability thinned. There were throaty warning sounds when tasty morsels came into dispute.

Once, abruptly, the pack scattered. There were savage snarls, then scuffling.

One fighter was knocked right on his great back, clawing the air with all four paws, his long red tongue thrusting between teeth furiously bared. But he kept on rolling, and landed on his feet. As fast as that, the quarrel was over.

Another huge beast seemed to have a particular dislike for a male a mite smaller than himself. He repeatedly rushed him, until he had driven the other grizzly away.

Nobody knows the grizzly well, but a little band of scientists in Yellowstone Park is in process of finding out more about this animal than has ever been learned before.

Tagged and tattooed. Drs. John and Frank Craighead, twin brothers, and staff are in the midst of an intense study of the grizzly throughout his present range. Sponsors include the National Science Foundation, the Wildlife Management Institute, and the National Geographic Society. For two years, the scientists have been harmlessly trapping the bears, knocking them out temporarily with drug-laden darts, weighing, measuring, tagging, and tattooing them, and releasing them to be recaptured later and examined for comparative data. The Craigheads even plan to attach miniature radio transmitters to some of the bears, so that their wanderings can be tuned in on and their positions pinpointed by triangulation.

Until now, knowledge of the bears has been based largely on the field notes of a very few men who have had a chance to observe grizzlies from time to time in the wild.

One of the most important collectors of firsthand information is tall, big-framed David Condon. Now assistant superintendent of Great Smokies National Park, he was chief naturalist at

[Continued on page 214]

FIRING A DRUGGED DART from a carbon-dioxide gun at a trapped grizzly, Dr. John Craighead watches intently while an assistant times the drug, which should render the bear helpless within four minutes. He can then be weighed, measured, tagged, and tattooed for science. This picture was taken in Yellowstone Park, but the research covers the grizzly's entire range.

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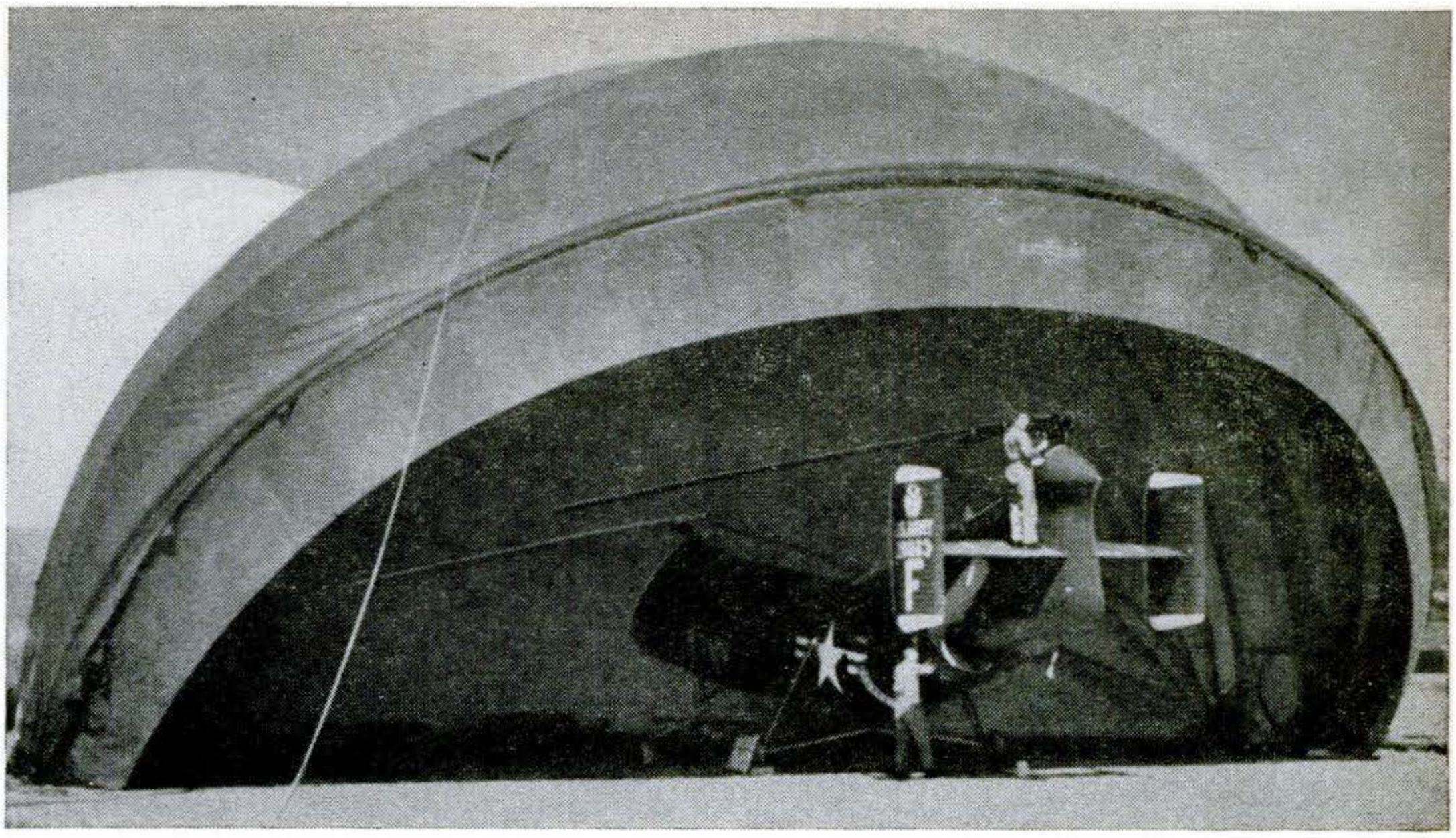
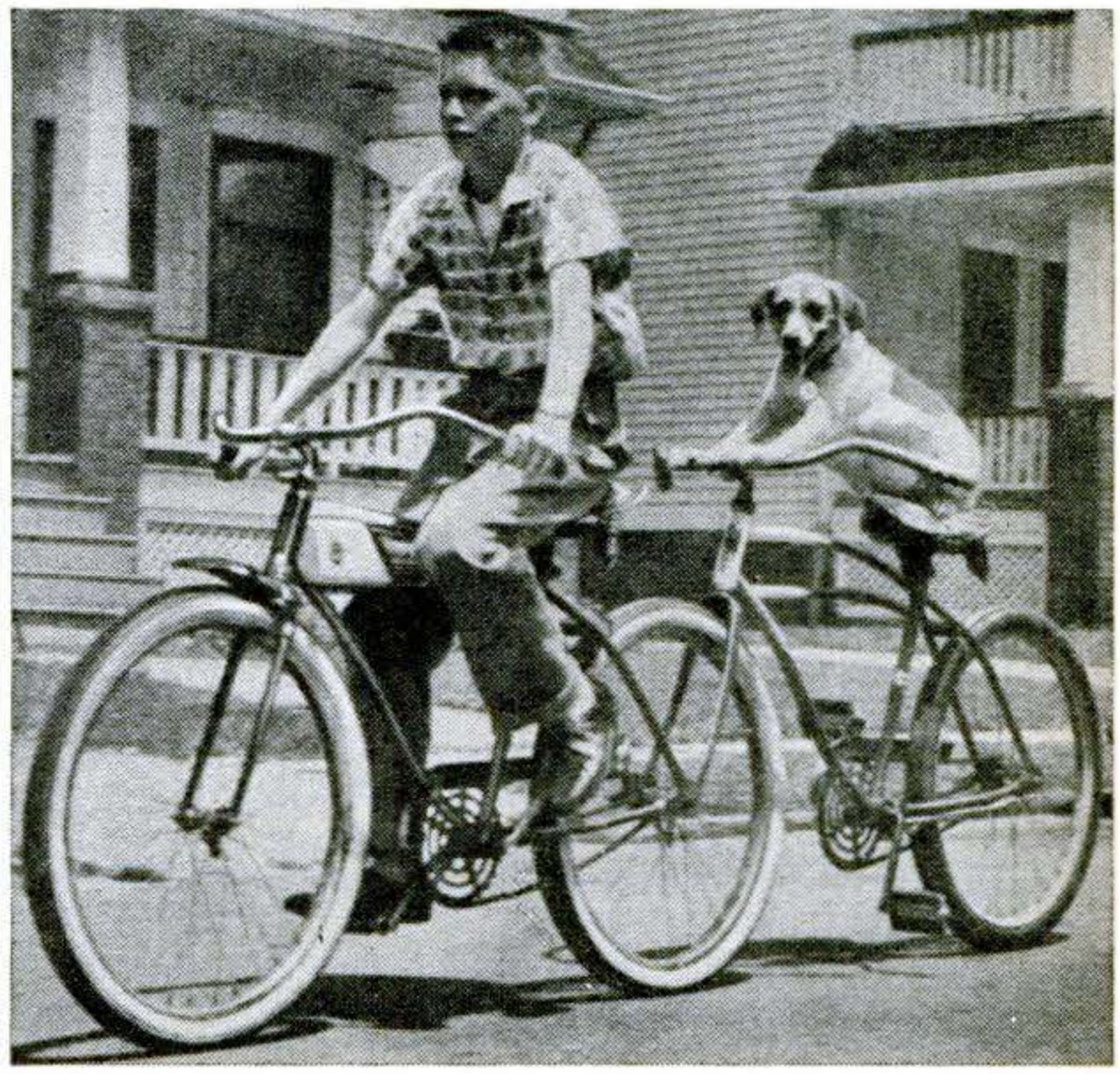


Inflatable hangar

Air pressure and a lightweight metal frame support this portable aircraft-maintenance hangar developed by the Army Quartermaster Corps. The half-oval structure is inflated by a 1½-hp. low-pressure blower. The frame holds the fabric up as air is released when an end is opened to get a plane or helicopter in or out.

Fallout-shelter kit

Radiation absorption is cut 99.5 percent by this basement fall-out shelter, according to the manufacturer. After the steel shell is assembled with simple tools, the side bulkheads and top are filled with sand. It accommodates six. Wonder Building Corp. of America sells it for $295 f.o.b. Chicago.



Bicycle home-built for two

Gary Helmerick, a newsboy in Cleveland, built this tandem oddity. He removed the front wheel of the trailing bike and assembled the fork on the sprocket of the first. Now his pooch, Queenie, can accompany him on his route without undue inconvenience. She used to ride on a rear package rack before she got a seat of her own.

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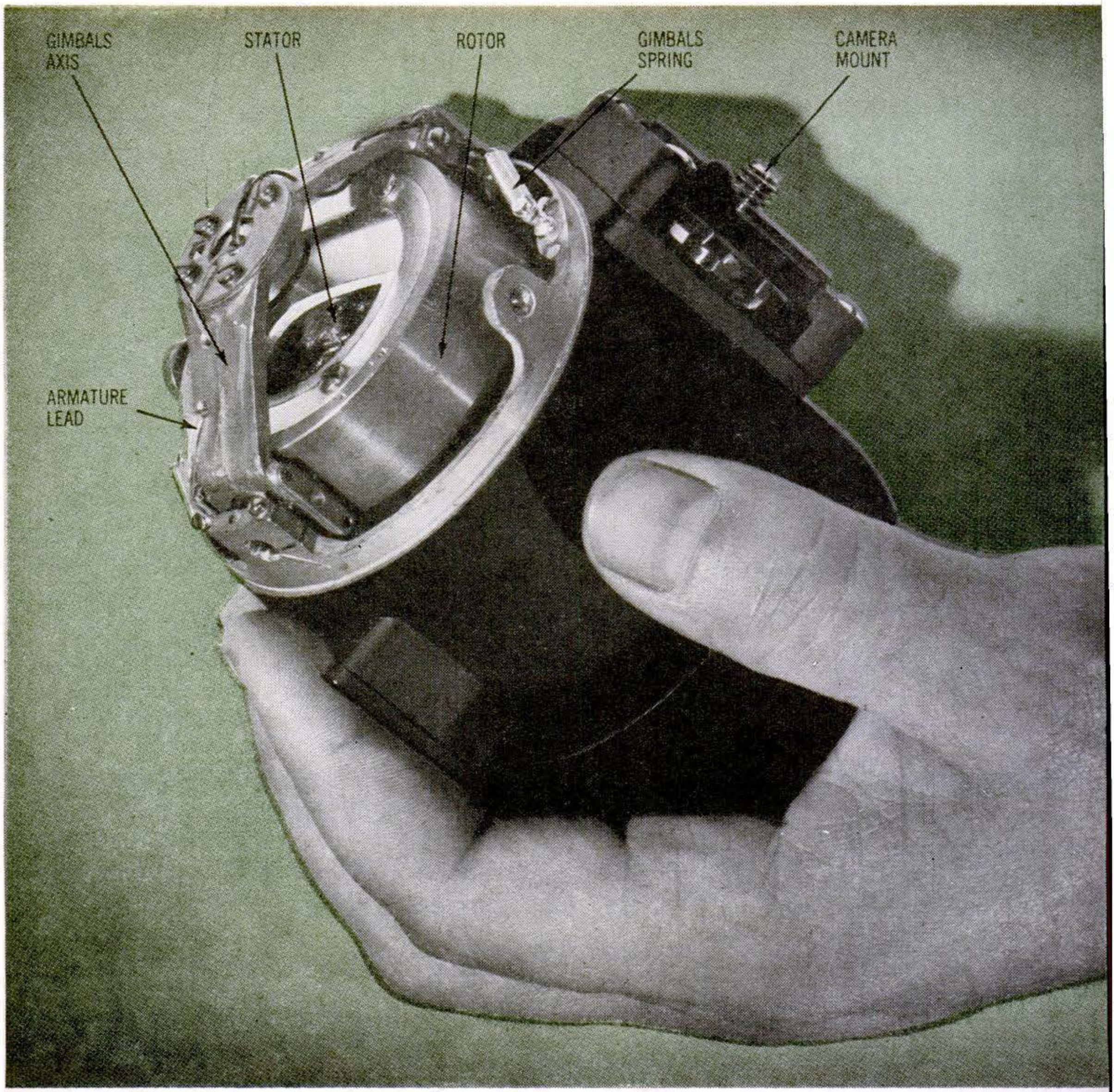

"INSIDE-OUT" MOTOR: Gimbals springs carry the current, since extra wires would upset critical balance. Gyro frames are mounted at 36-degree angles for more resistance to vertical deflection. Helium in the sealed case lessens friction, carries heat away from bearings.

Invisible Tripod Takes Jiggle Out of Photos

A VIBRATING helicopter, a hand-held camera equipped with telephoto lens —and a batch of remarkably sharp aerial photos. Sound like an unlikely combination?

Not at all, according to a small but enthusiastic group of professional photographers who have been using a new camera stabilizer. It's a little black capsule that weighs 24 ounces and sells for about $400. Inside are two delicately balanced gyroscopes that turn at 21,000 r.p.m. and provide both vertical and horizontal stabilization—in effect, a legless tripod. The worse the vibration, the more dramatic the results, according to the stabilizer's

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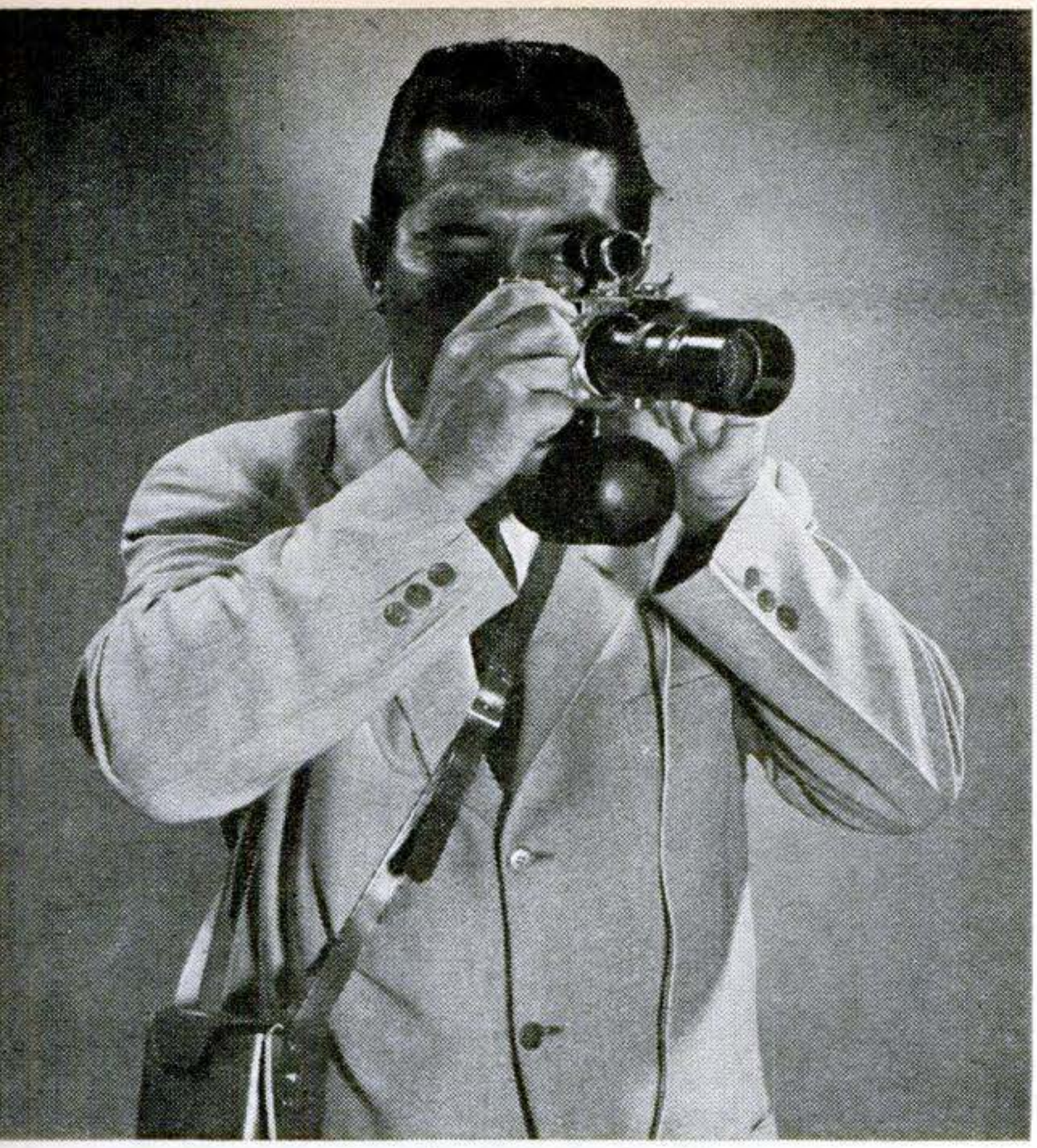
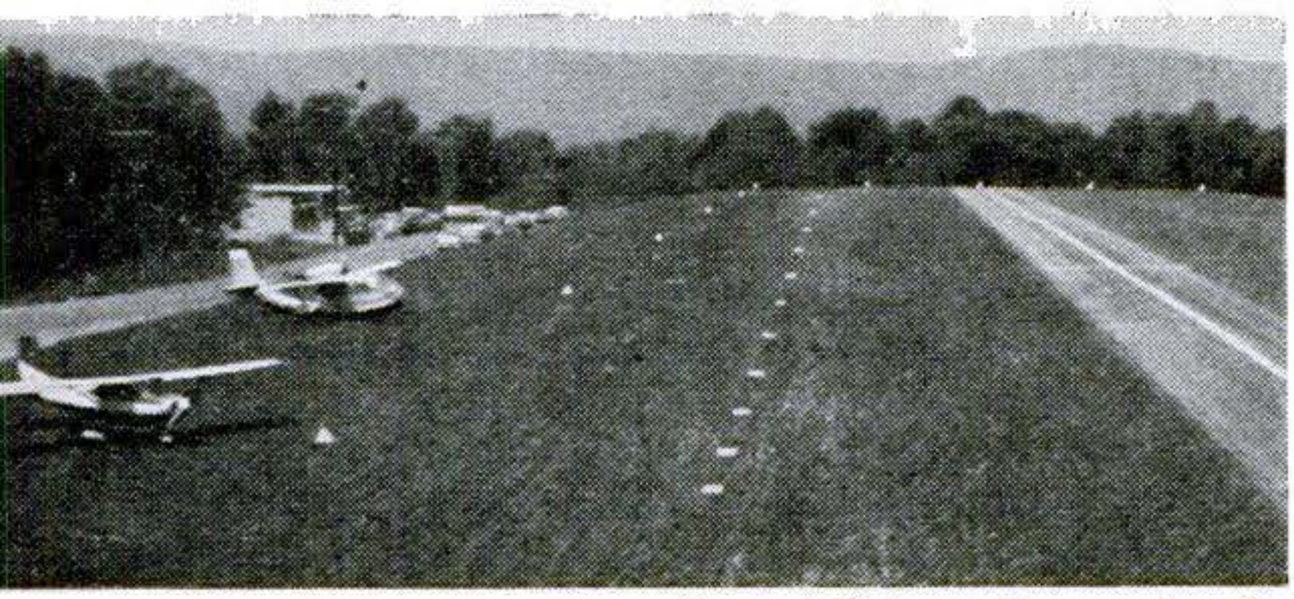


RELAX—let the gyros do the work, says the manufacturer. Electric power is supplied by portable, rechargeable nickel-cadmium battery **in leather case or by transistor inverters that change auto or aircraft DC voltages to required 115-volt, 400-cycle AC current.**

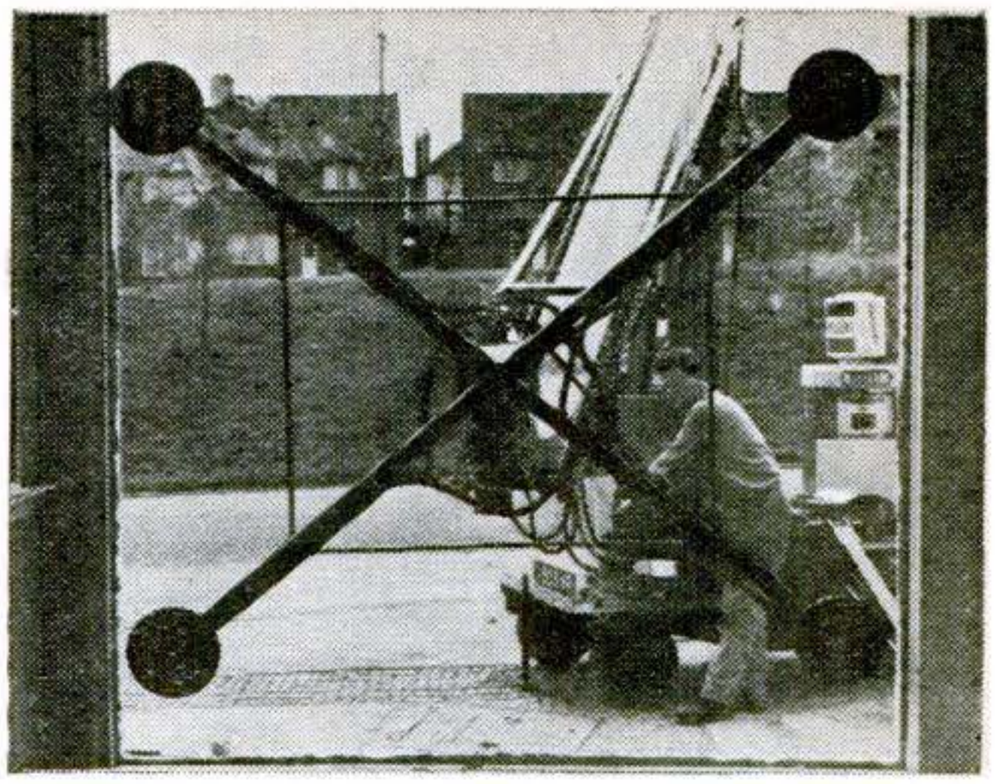


HELICOPTER PHOTO from 25 feet above airstrip shows 10 cards at 50-foot intervals starting 650 feet away. Each card bears two-inch letters or numerals. According to tests by the manufacturer, only the first three cards could be read with 10x50 binoculars not equipped with a stabilizer. All cards, the farthest being 1,150 feet away, could be read with the same binoculars equipped with a Kenyon unit.

manufacturer, Kenyon Products, Deep River, Conn.

The device was designed for movie cameras and binoculars as well as still cameras. In fact, there's talk of adapting the stabilizer to smooth out rifle fire, and even of building a smaller model to steady a surgeon's hands.—*Carlton Bucher.*

Plate-glass handler

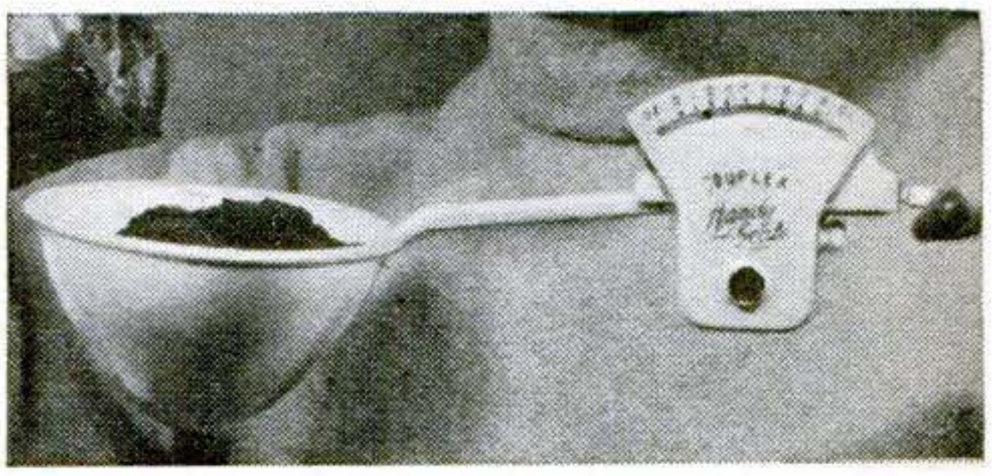


TEN-INCH SUCTION CUPS are exhausted by the same pump that powers the beam. Device also handles sheet metal, smooth paneling.

JOINTED ARM swivels horizontally. Controls are in the truck. Handler is owned by Hill Brothers Glass Co., Birmingham, England.

Glass weighing up to 560 pounds can be positioned accurately in a second-floor window by this octopus-like British electric truck. The vehicle's batteries power a hydraulic pump that operates the 24-foot beam. Four suction cups at the end of the beam securely grip the glass.

How to weigh a spoonful



The handle of this plastic kitchen spoon contains a spring balance and a small scale. With it, a housewife can weigh cooking ingredients up to eight ounces. It was shown in London.

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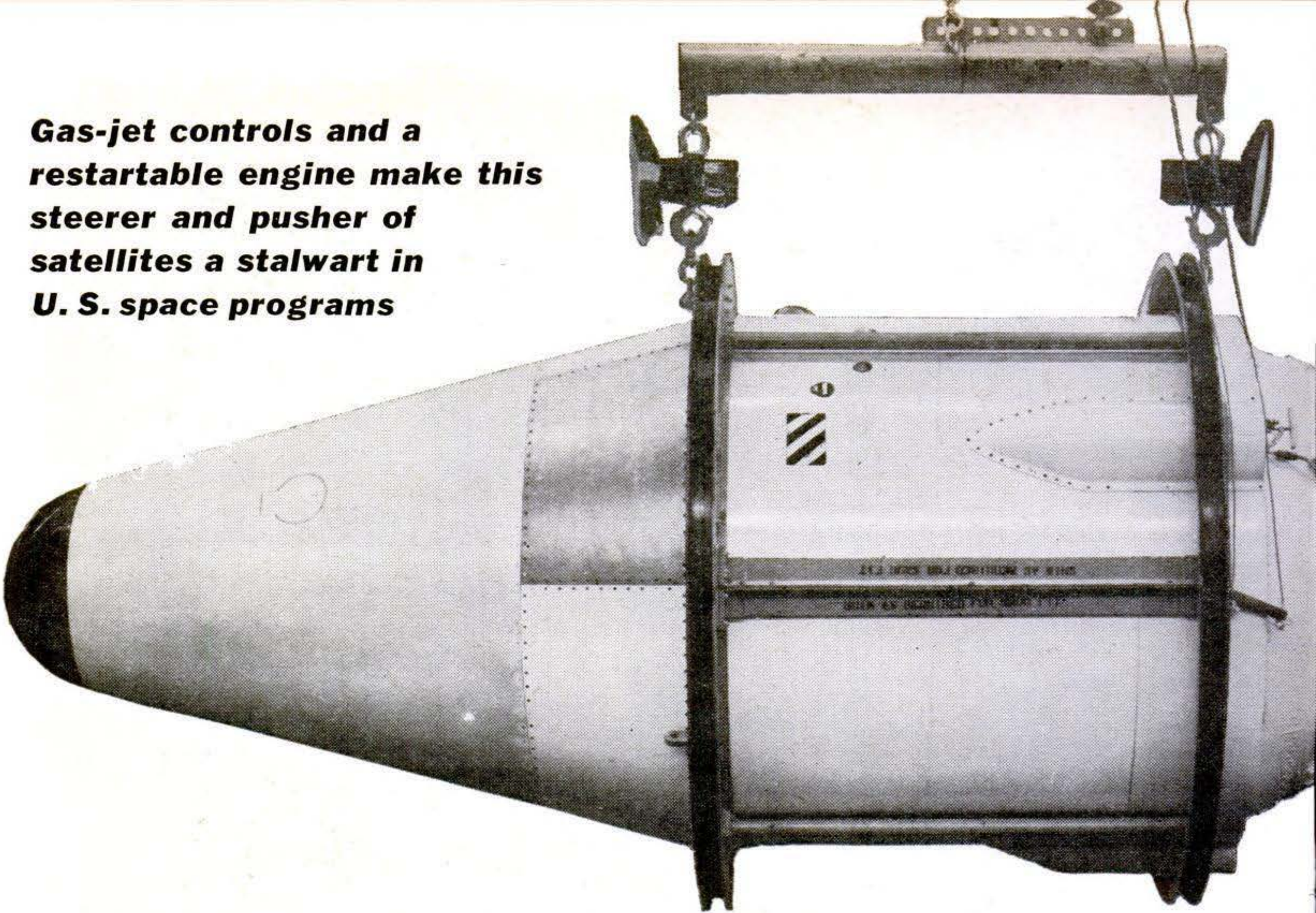
Gas-jet controls and a restartable engine make this steerer and pusher of satellites a stalwart in U. S. space programs



Acrobatic Agena: Prize Performer in Space

By Bob Mount

AGENA, a billion-dollar "space jeep," is a wonderfully nimble vehicle-of-all-work that is making history. Its job is to steer satellites, and even give them a push if necessary. One of its most important missions may be sky-spying.

All other space craft, once launched, have been beyond flight control. Agena (a-*jee*-na), named for a little Greek island whose sailors helped save democracy more than 2,000 years ago, is different. This barrel-shaped celestial traveler, as long as a big car but only five feet in diameter, can do all sorts of useful tricks.

In the first place, it is unique among orbiting vehicles in having its own rocket engine. An Atlas or Thor missile is used as a booster to launch the space jeep. Then, when the booster burns out and falls away, Agena's engine carries on.

Gymnastics in space. This rocket can be shut off and restarted in flight to change a satellite's orbit or steer a straying space probe back on course.

Even more remarkable is Agena's ability to maneuver in space. It can roll left or right. It can raise or lower its tail to any angle desired. It can spurt forward. It can dip or lift its nose until vertical, and then move sideways. Or it can do a somersault and travel backward.

Combination maneuvers can point Agena in any direction and hold it there.

These gymnastics made it possible for the first time, last August, to orbit a satellite and recover its payload.

Only a handful of the tubby Agenas have been launched to date, but they've

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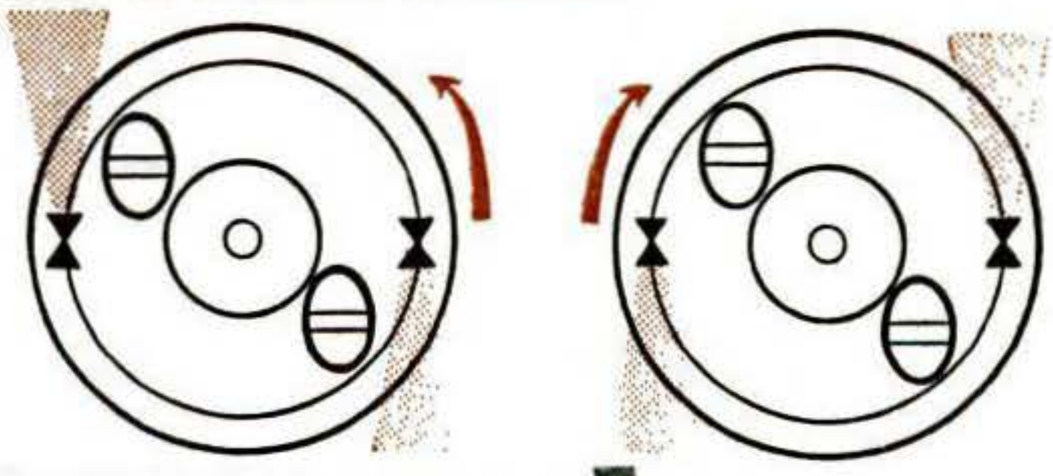
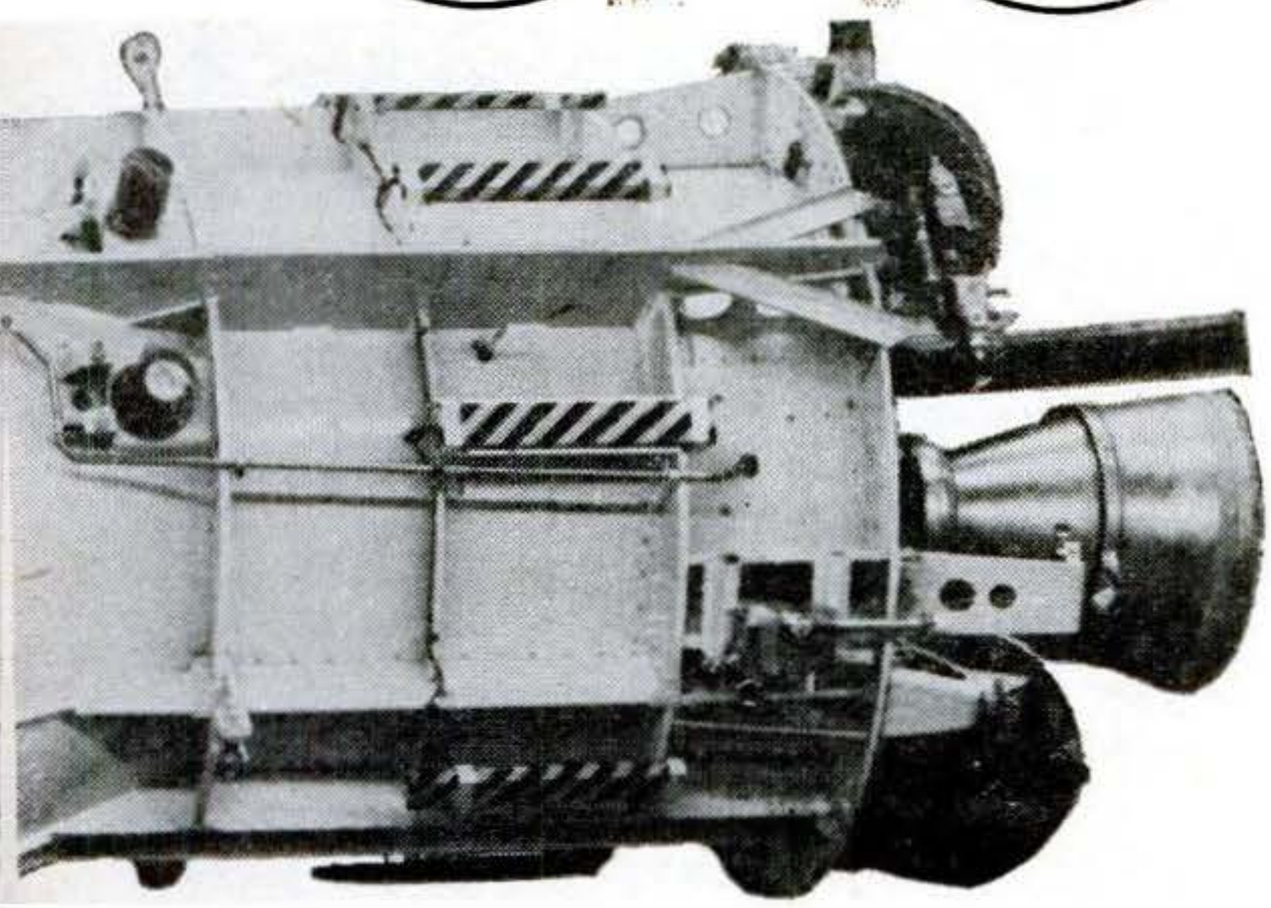
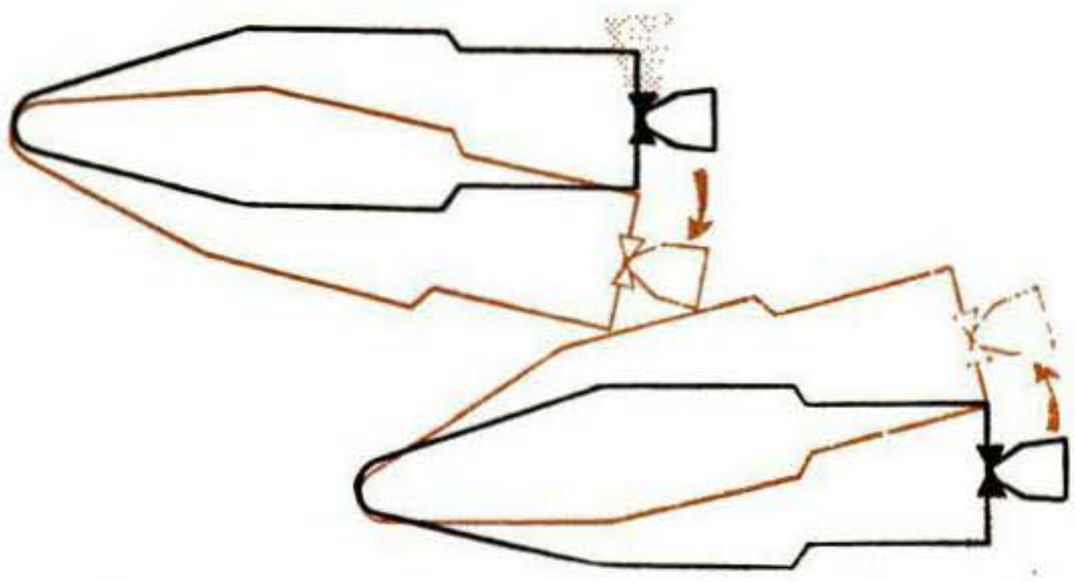
How it is made to rotate





...and do somersaults



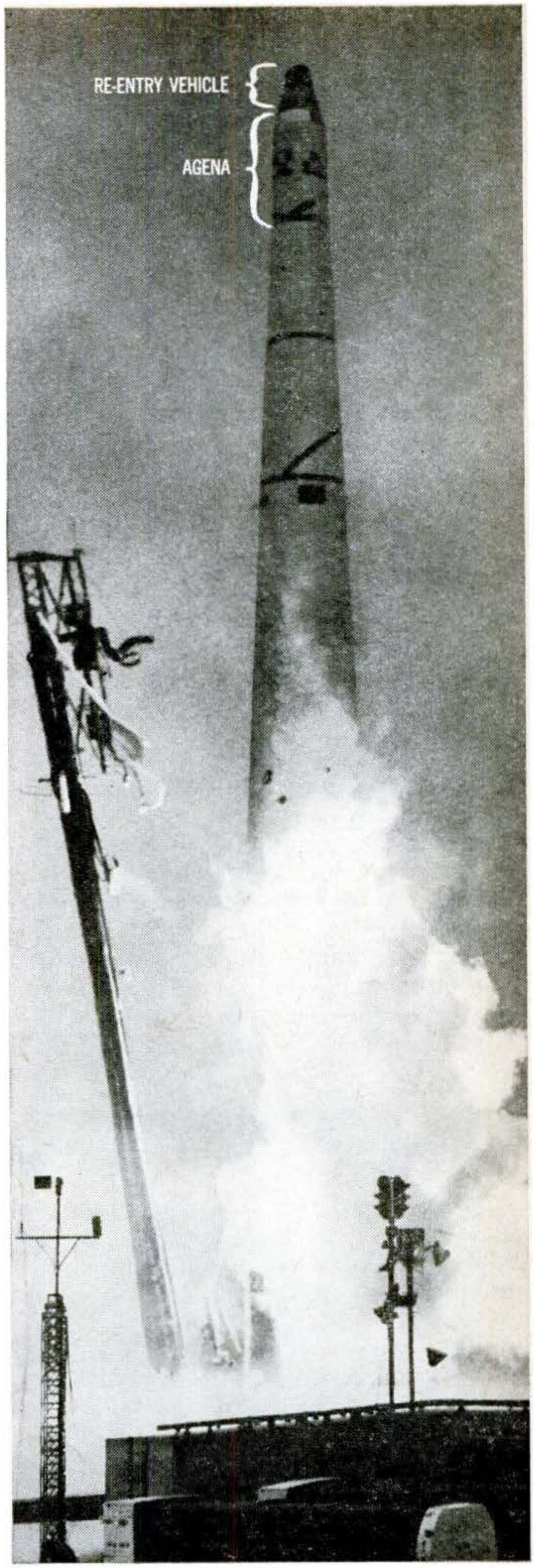
AGENA'S AGILITY springs from two pairs of pressurized-nitrogen jets, located at its tail. The drawings at top (a straight-up look at the nozzle of the rocket and its twin nitrogen tanks) show how alternate pairs of jets can roll the vehicle either way. The lower drawings show how matching pairs of jets can change the satellite's angle or flop it over.

poled 9 satellites into orbit in 14 tries, for a .643 batting average.

Upcoming jobs. The most urgent missions for Agena are military—and defensive, as befits its name. They will cost several hundred million dollars by the end of this year.

Samos-Agena satellites will replace the optical eyes and electronic ears of the downed U-2 sky-spy planes.

Midas-Agena satellites will scan the earth for infrared trails of hostile rockets. Midas warnings could avert a space-age Pearl Harbor.



HISTORIC LAUNCH on Aug. 10, 1960, with a Thor missile as booster, hurled a Discoverer-Agena into an orbit from which, for the very first time, its nose cone was recovered.

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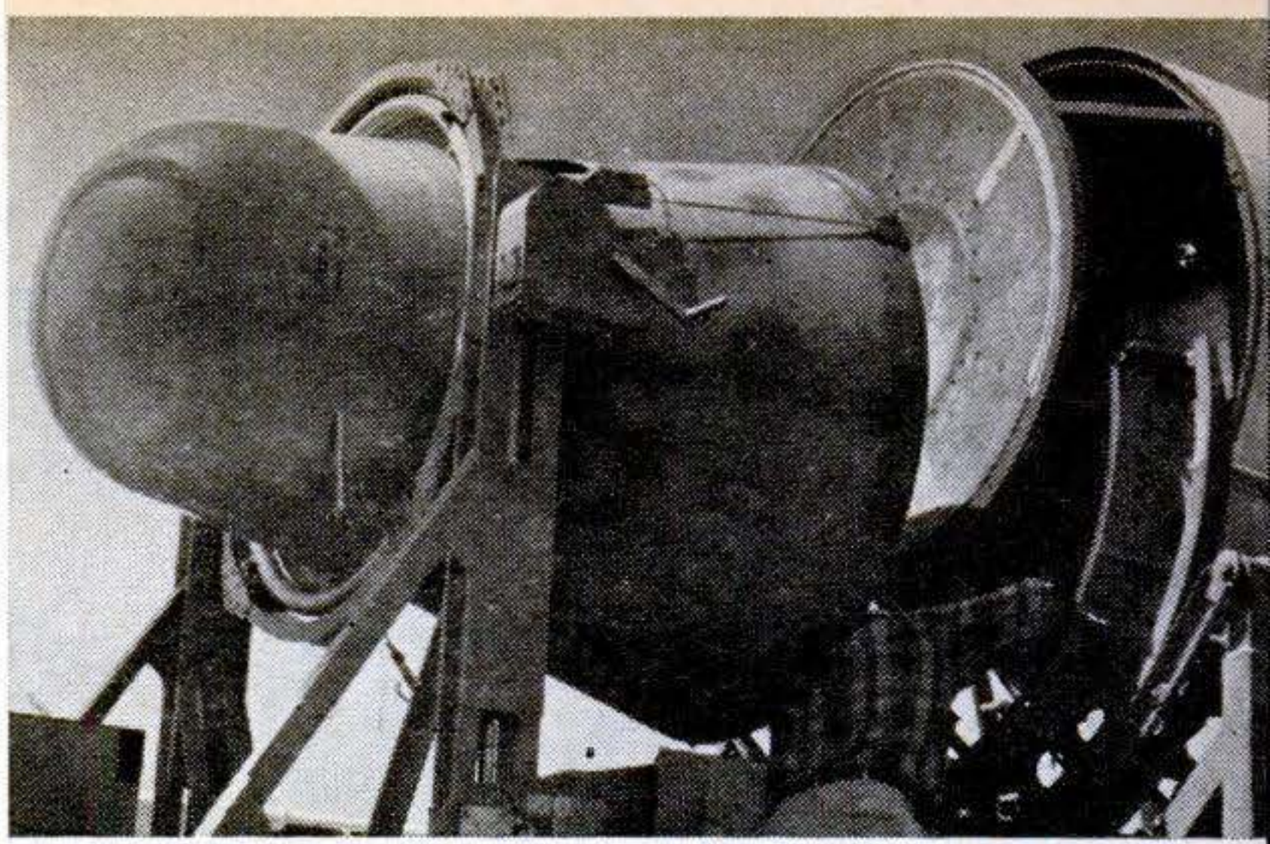
Many other Agena projects are planned purely for scientific work. Those listed here will account for 130 launchings by 1970, at a cost of more than $1.3 billion:

- Discoverer-Agena satellites have already shown us how to pluck a payload out of orbit, a trick that had to be mastered before the manned-satellite Project Mercury can be a success. A Discoverer also made the first polar orbit, and became the first satellite to ride around the earth in a stabilized position.
- Ranger-Agena probes will send instruments to the moon to solve the mysteries of the lunar landscape (1961-62).
- Nimbus-Agena satellites will scan the earth's clouds to provide information for accurate, long-range weather forecasts (1961-62).
- Orbiting Astronomical Observatory (OAO)-Agena satellites will poke remote-controlled telescopes into the clear space beyond the atmosphere so that astronomers can peer at the center of our galaxy for the first time (1963-64).
- Other Agenas will orbit the sun to study its elements, and check the oddities of Venus and Mars (1962 on).

These are only a few of the projects that the new space jeep makes possible.

The heart of Agena's control system consists of four jets of pressurized nitrogen. Two pairs of them, each set back to back, are mounted at opposite edges of the space jeep's rear skirt. Any two jets can be opened or closed.

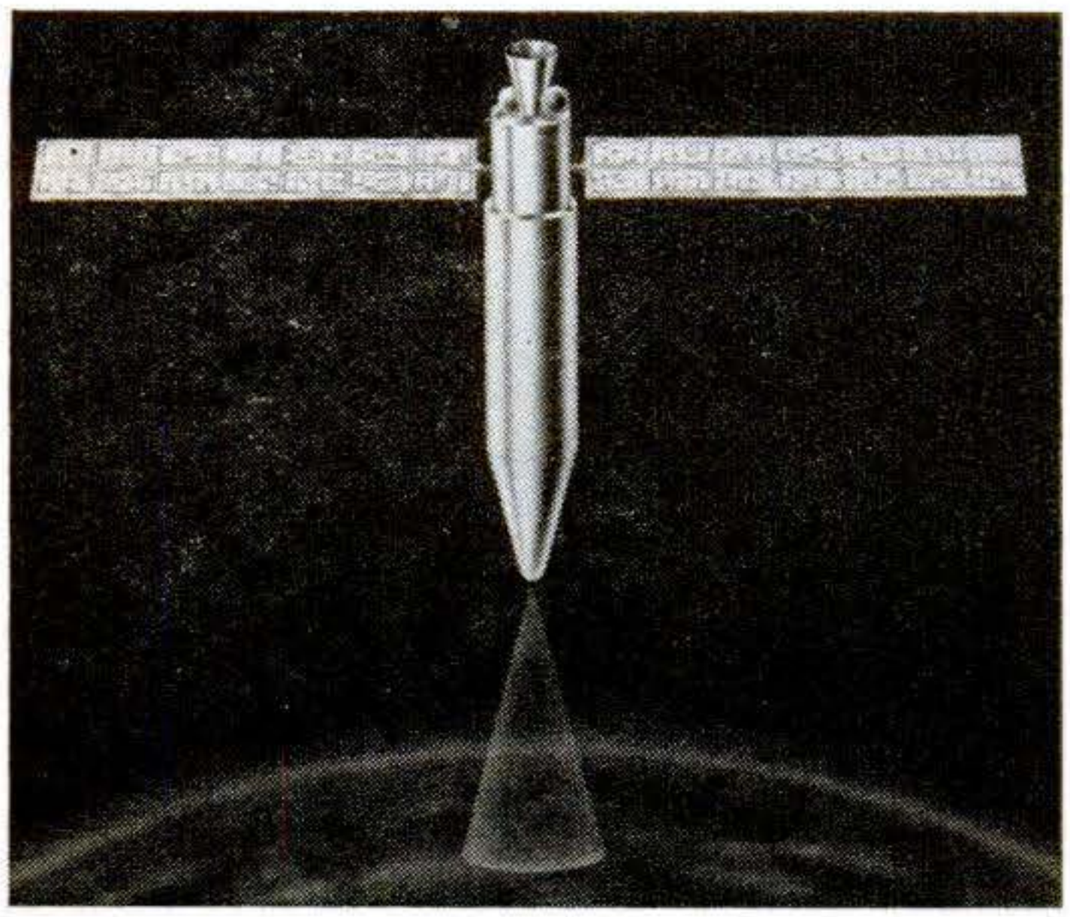
One combination, for instance, makes Agena roll either way around its long axis, like a spinning bullet. Another moves it up or down around its short axis, like a tumbling bullet. Simultaneous spurts from all four jets stop any motion. While Agena travels in space, the gas jets act as trim tabs to keep the jeep aimed.



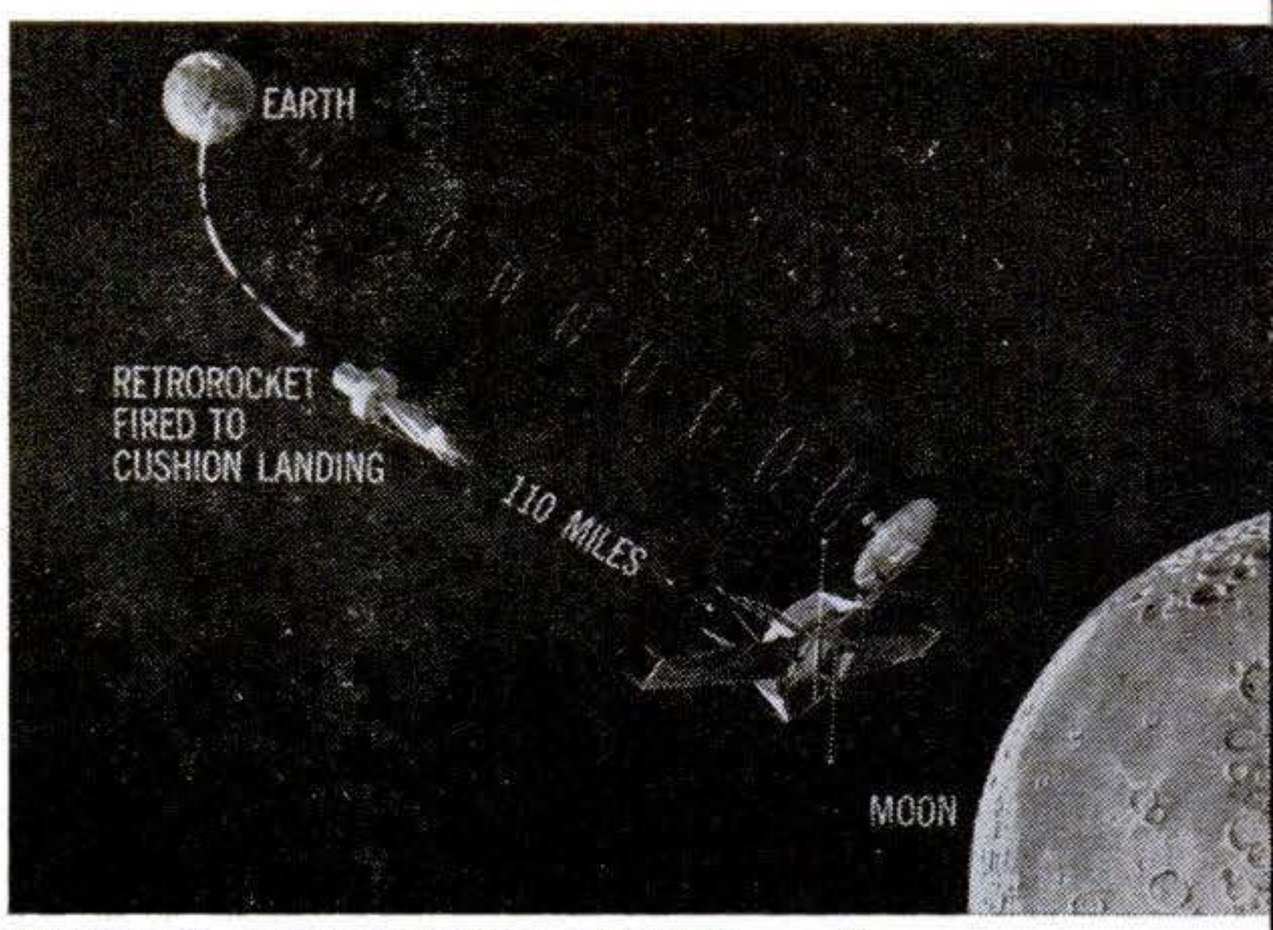
NOSE CONE, the re-entry vehicle, is attached here to Agena prior to launching. A fairing hides the retrorocket that will separate them later.

Infrared eyes. The experimental Discoverer-Agena satellite was designed to cruise with its body parallel to the earth's surface, aimed always at the horizon. Since the engineers couldn't go along to operate the nitrogen trim tabs, they put an infrared eye in charge. The eye, set in the space jeep's nose, was adjusted to detect the earth's infrared horizon.

Automatic controls kept the infrared eye aimed at the horizon. When Agena's nose rose too high, the eye saw only the



RIDING NOSE-DOWN, Nimbus-Agena satellites, nudged into position by jet "trim tabs," will scan the earth's cloud cover to aid weather forecasts. Solar energy will run the scanner.



LANDING INSTRUMENTS GENTLY on the moon will be done like this by a Ranger-Agena, which will place a seismograph, thermometer, and radio transmitter there to record for weeks.

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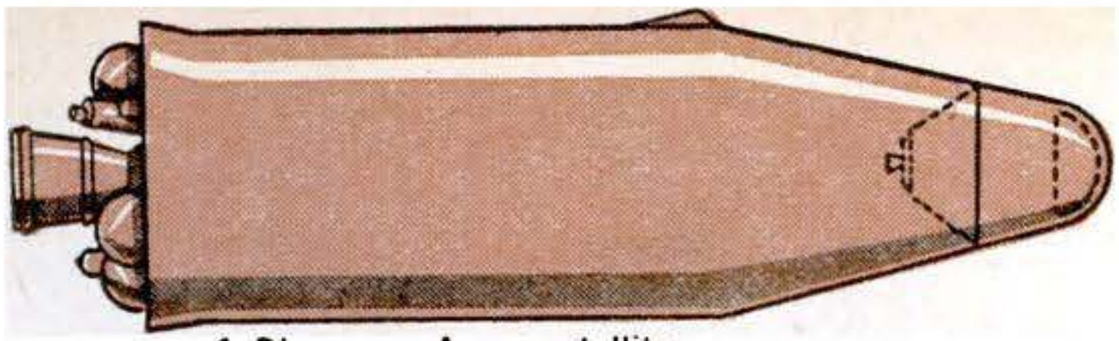
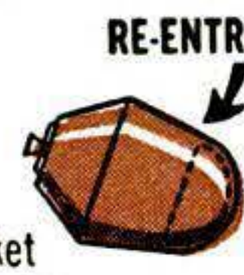
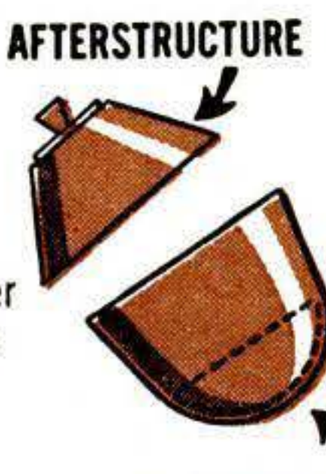


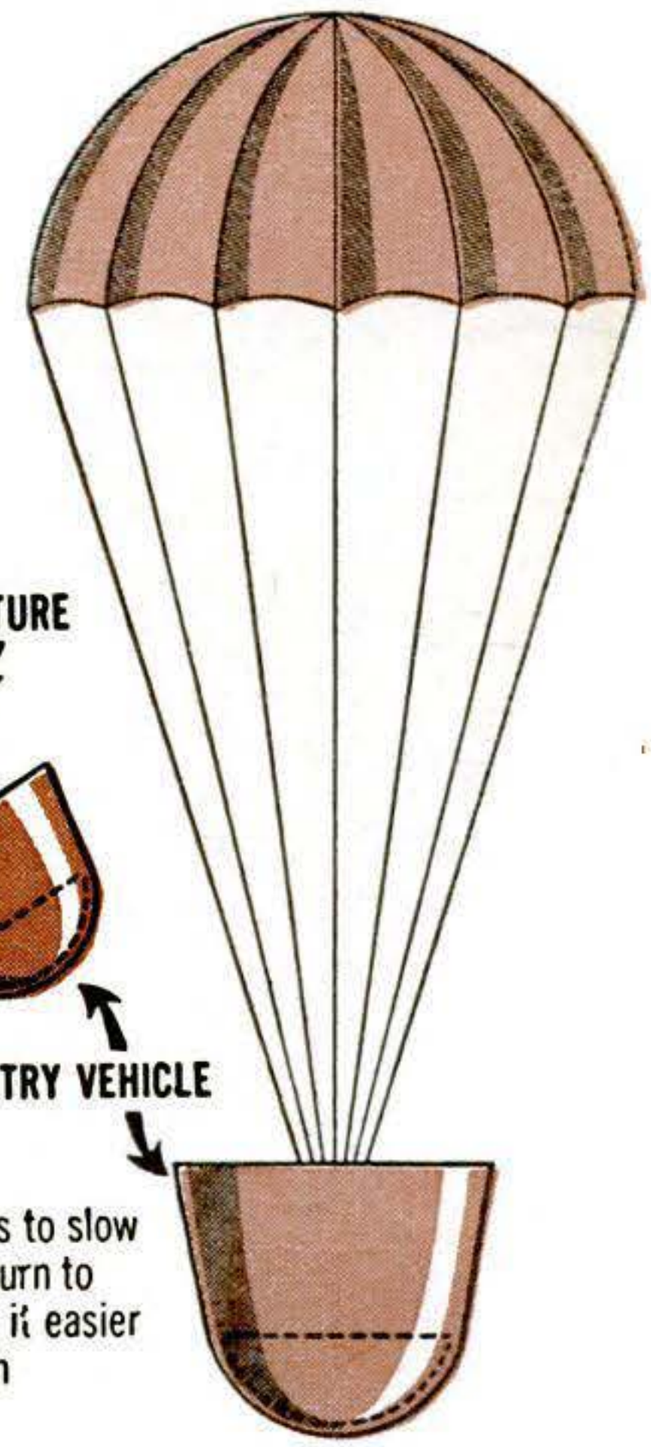
1 Discoverer-Agena satellite has been flipped to ride tail-first in orbit



2 Firing of retrorocket separates Discoverer from Agena



3 Spent retrorocket falls away just before Discoverer enters earth's atmosphere



4 Parachute opens to slow Discoverer's return to earth and make it easier to see and catch

HOW TO RECOVER a space traveler from orbit is shown in this sequence of drawings. The technique here was responsible for the U. S. Air Force's first successful capture of a re-entry vehicle, near Hawaii, last August.

cold sky. An electronic command to the jets then told them to lift Agena's tail until the earth's horizon swung back into view. When the vehicle's nose drooped and the eye saw only the hot earth and no horizon, orders were shot to the jet trim tabs to get that tail down.

With these controls, Discoverer achieved the first fully stabilized orbit with respect to the earth's surface. Agena A worked so well that the Air Force began to work out variations. Agena B can be aimed anywhere.

Midas, Samos, and Nimbus satellites will be pointed downward, scanning the earth. OAO satellite-telescopes will be aimed wherever an astronomer chooses. Ranger probes will be aimed at the moon.

Pitching a floater. In the early Discoverer-Agena satellites, one main objective was to recover a payload from space. The designers installed a retrorocket in the satellite's nose, pointing toward Agena's tail. The front end of the satellite was covered with a re-entry nose cone. The payload was tucked between the nose cone and the retrorocket.

Agena was launched into a circular polar orbit. The satellite's track was like a ring in space above the earth's poles, with the globe rotating inside the ring.

For a recovery area, the Pacific Missile Range directors chose a huge square of ocean near Hawaii. As the satellite passed over the North Pole and began a southward trip over the Pacific, the space jeep was somersaulted so that it was traveling backward, with the nose pointed slightly downward. Over the North Pacific, the retrorocket was fired, and the nose cone, payload, and rocket shot away in the opposite direction.

The effect was somewhat like pitching a baseball out the rear of a speeding car. The ball would continue moving in the direction of the car's motion, but at a lower speed.

The Discoverer payload's speed was reduced so that gravity would pull it back into the earth's atmosphere as the jeep's chassis continued in orbit. The nose cone protected the recovery package from the fierce heat of re-entry into the dense atmosphere. Then a parachute blossomed to lower the payload—sealed so it would float—toward the ocean for recovery.

Slight control errors balked success until the thirteenth try. That "unlucky" shot turned out to be perfect, and the U. S. Air Force made the first recovery of an object that had been in orbit.

B-58 rocket engine. Agena's power comes from a liquid-fueled Bell rocket engine of 15,000-pound thrust. Curiously, it was intended for the B-58 Hustler bomber. Instead, it wound up in outer space. Choice of red-hot fuels (hydrazine and nitric acid) forced a switch of a few engine parts to withstand super-high temperatures, but basically the engine is unchanged.

[Continued on page 220]

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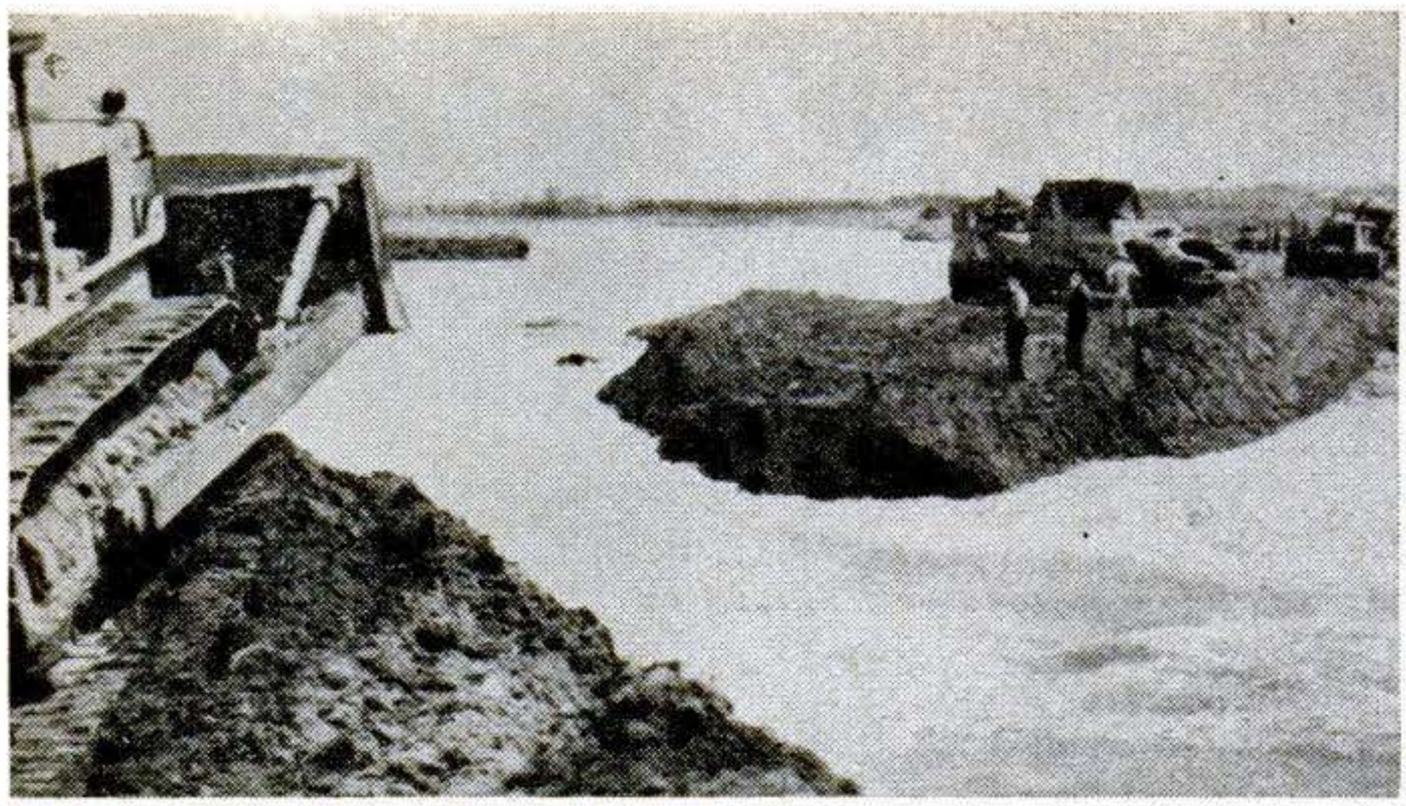
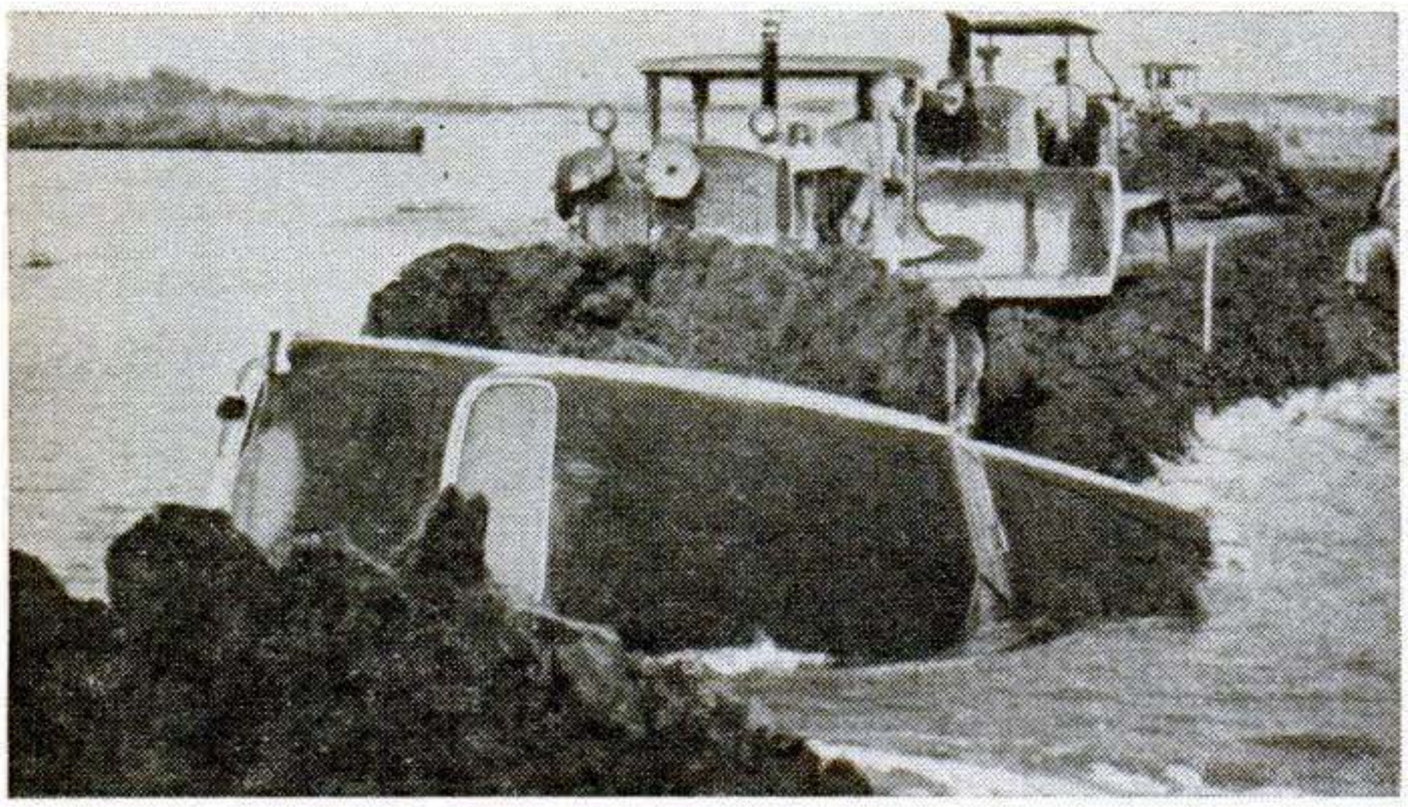


Water pours through gap in dike . . .

. . . auto is pushed in to anchor dirt . . .



. . . and more earth is pushed on it to plug hole.

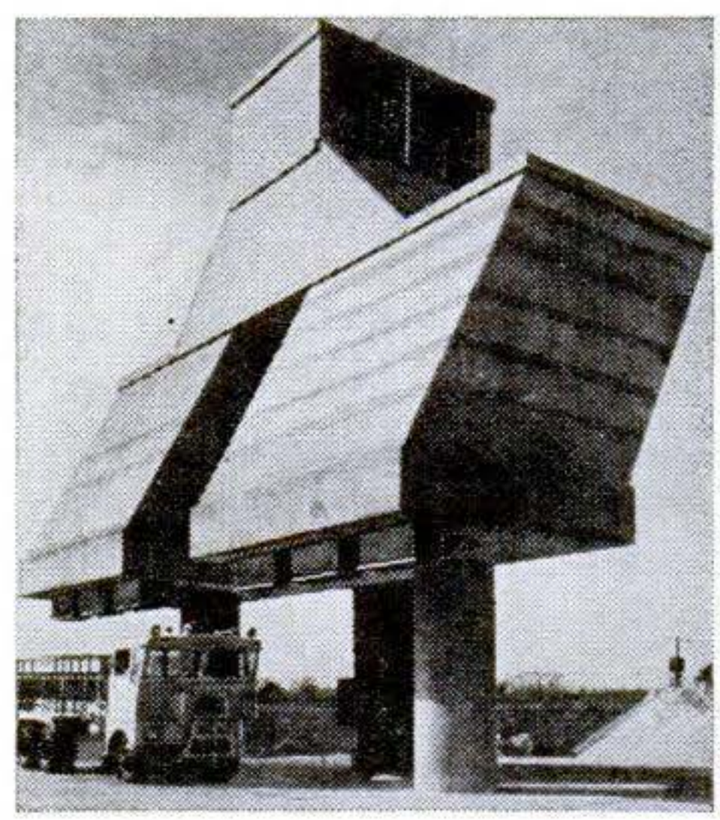
Plugging a hole in a dike

Frank Gaskill, a contractor at Silver Lake, N. J., didn't stop a leak in this dike with his finger, like the famous Dutch boy. He used his automobile.

When water from the Atlantic Ocean tore through a temporary dirt embankment to threaten 5,500 acres in Lower Alloways Creek Township adjacent to Delaware Bay, he had his car pushed into the gap to provide an anchor while bulldozers did the earth-moving job.

Free umbrellas

Unclaimed umbrellas left in the lost-and-found bureau of the Chicago and North Western Railway are put to good use during unexpected showers. They are lent free to commuters at the railroad's Chicago terminal. It's all done on the honor system. The only requirement is that the umbrellas be returned—for borrowing by other commuters caught in other showers.



Sand tower

This leaning reinforced-concrete bunker on the edge of Britain's new London-Birmingham motorway has twin compartments, each holding 60 tons of sand and cinders for use on ice.

Bulk material is loaded by a ground-fed hopper that fills either compartment in just over an hour. It is discharged from air-operated chutes that fill a 12-ton truck in three seconds.

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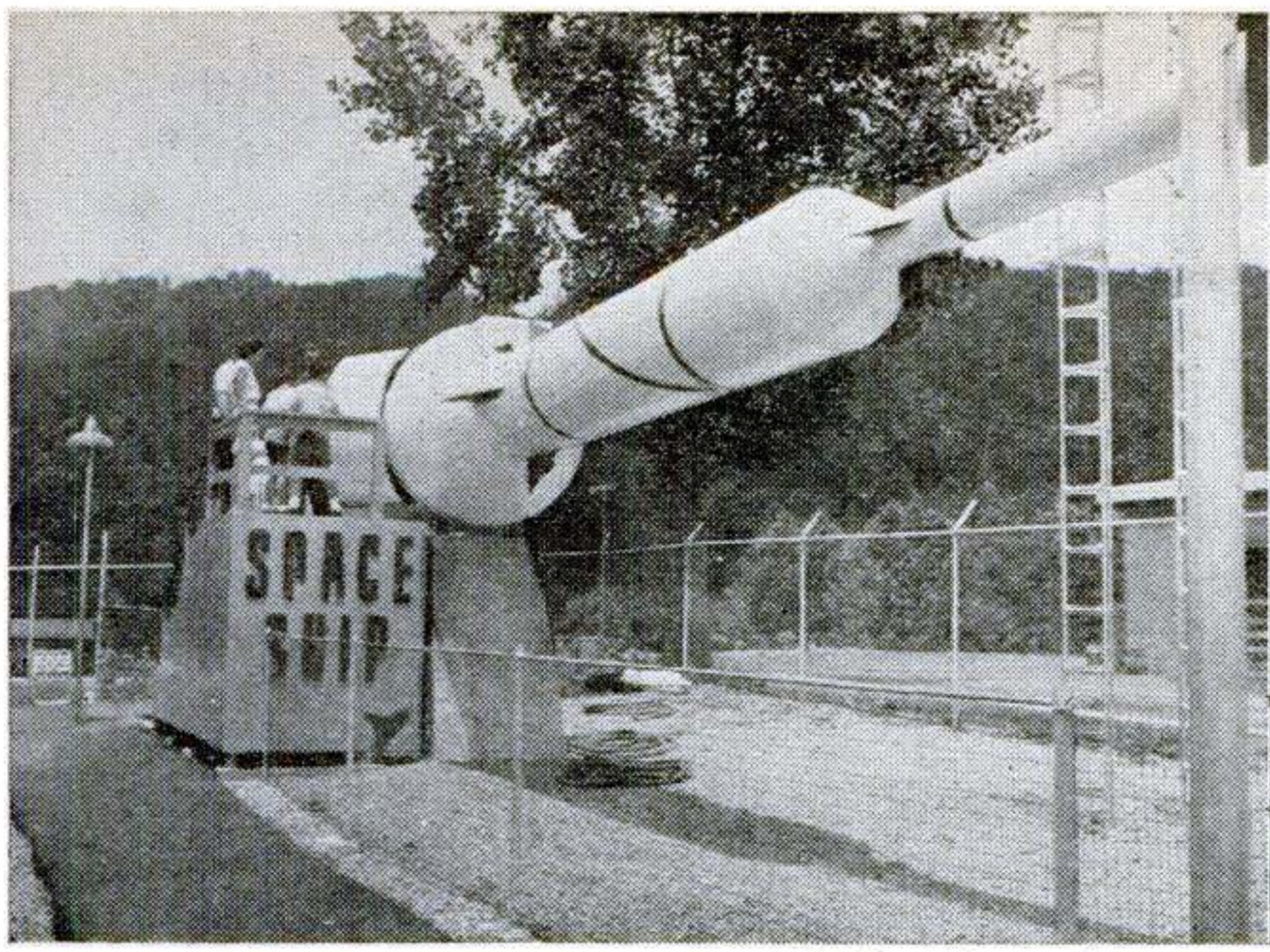
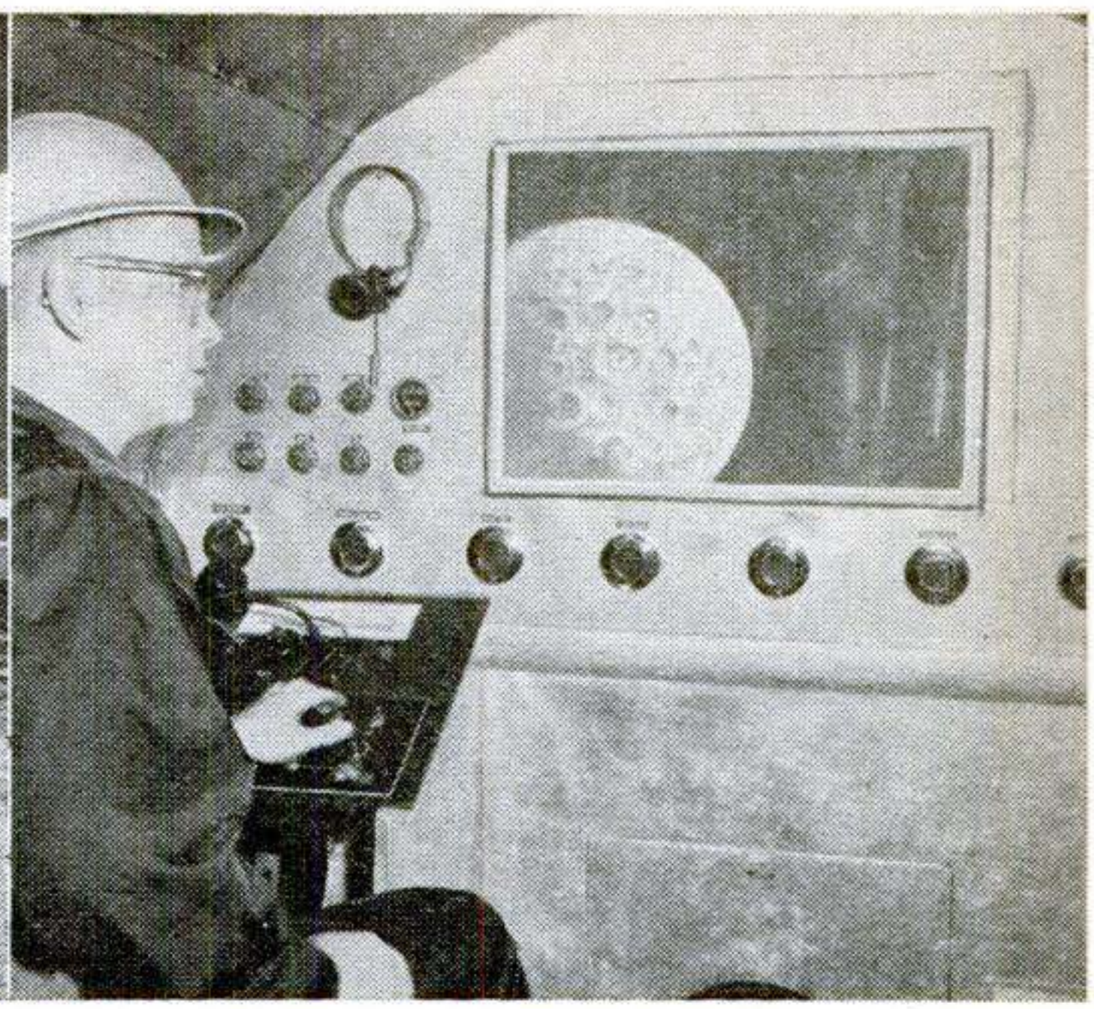


MODEL OF SPACESHIP is 80 feet long, has an air-conditioned cabin that seats 16 strapped-in paying passengers. After a countdown, the pilot pushes a button that starts vibrators in the seats to give an illusion of movement.



MOON IS APPROACHED on screen as climax to the "flight," which takes 12 minutes. One bit of science fiction is added when another spaceship is "passed" and pilot Dan Stout talks to it in what purports to be Martian dialect.

For a fanciful flight to the moon

An authentic-looking spaceship—except that it's horizontal instead of vertical—stands ready for a "take-off" into space on a launching pad in a lot at Gatlinburg, Tenn.

The rocket is 80 feet long, has a 28-foot cabin that accommodates 16 passengers strapped to their seats. Vibrators in the seats give an illusion of flight. A screen on the instrument panel shows colored scenes, including the Milky Way, of a simulated trip to the moon. The animation is accompanied by appropriate remarks from the pilot, 17-year-old Dan Stout, who skyrocketed an idea from a high-school science-fair exhibit into a paying amusement-park "ride." His entire family participates: father, mother and one sister dressed as stewardesses, and a younger sister as "cabin boy." They say the project is educational as well as a money-maker.

Intercom on your telephone

A new intercommunications system that works on your phone will be available to telephone-company subscribers early next year.

It operates on a central control, a mike in the base of each extension phone, and a speaker on a nearby wall. Each extension can be used to dial outside calls.

For $25 installation, subject to local rules, and $6 a month, you get three phones and a door speaker.

Delivery man at door . . .

. . . is answered from basement.

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How a Pop-Up Toaster Works

SLICK engineering goes into the shiny gadget that serves up your breakfast toast as you like it. Early toasters were simple bread racks with heating elements around them. Today's models not only turn themselves on and off, but allow extra time for the first slice (when the devices start cold) and compensate for fluctuations in line voltage. They're adjustable to toast bread of various kinds, too, and to turn out the slices to your taste—from a golden tan to a deep melba brown.

One popular toaster almost takes the bread out of your hand. It lowers the bread by motor power and pops up the slices with a well-behaved, ratchet-cushioned lift instead of the mousetrap snap of older types. The motor, specially designed to withstand the oven heat, is switched on by the weight of a single slice of bread.

A separate small heating element in this machine, wound around a bimetalic strip, is connected in series with the four oven elements. It begins to heat the strip at the moment toasting starts. At a point determined by the setting of the toast-selection knob, the timer shuts itself off and begins to cool.

Toasting continues, however, until the timer has reached the end of its cooling cycle. Then it releases the toast racks and shuts off the ovens.

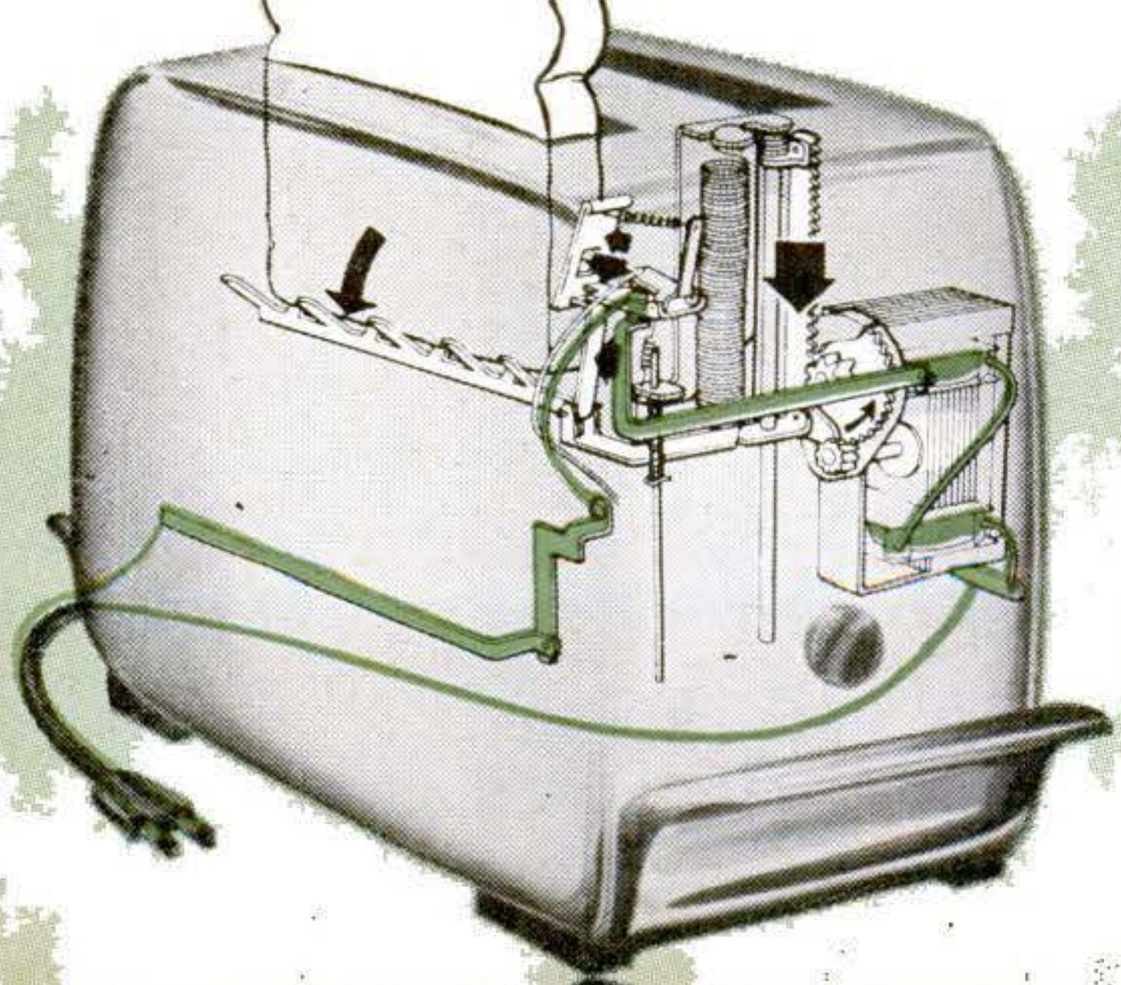
The Toastmaster shown here is made by the McGraw Edison Co., Elgin, Ill.

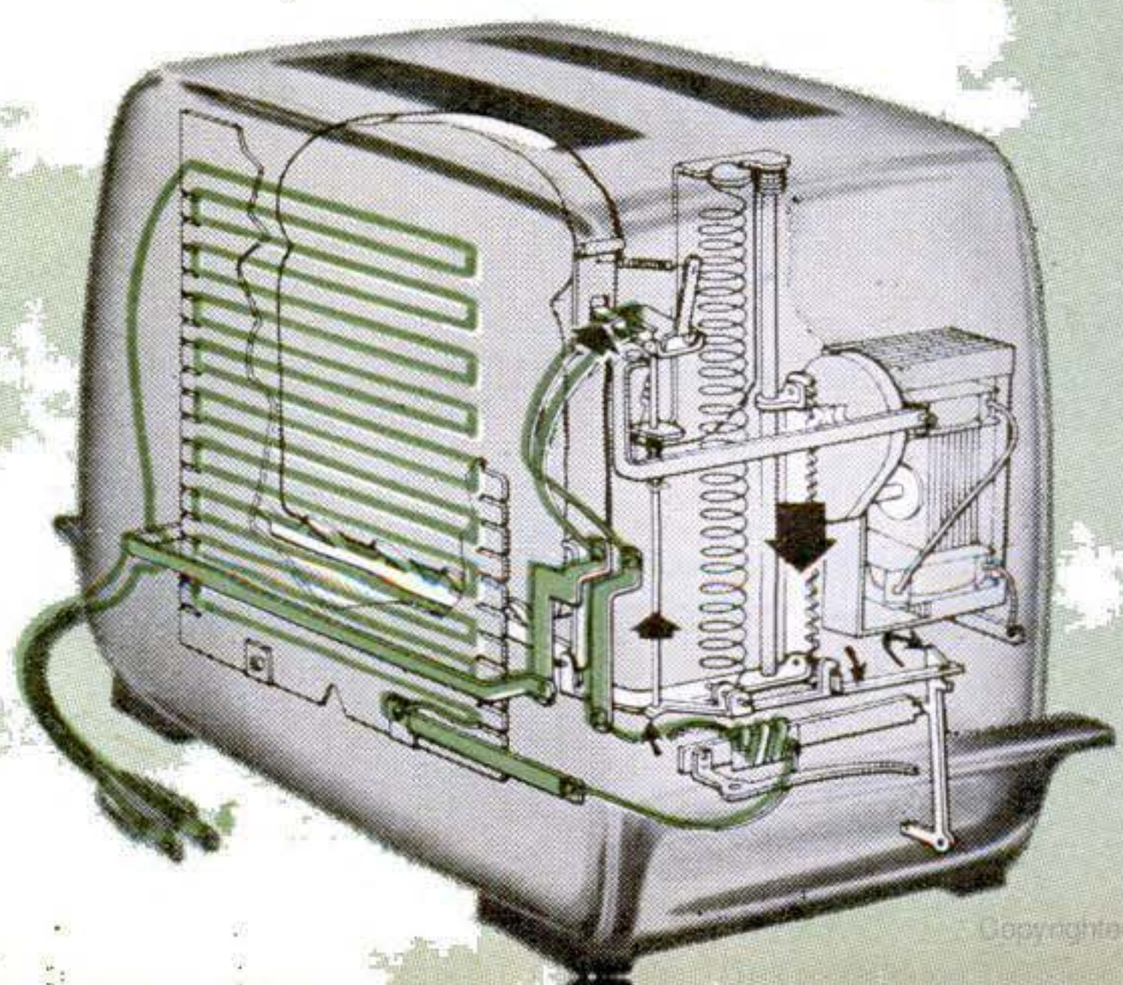
HERE'S WHAT'S INSIDE the chrome-plated case (right). This model has two bread slots, each flanked by two heating elements. The two toast racks are joined and pivot as one at the forward end. When they are in the up-slanting position shown, all current is off; but the switch mechanism is set to close the starting circuit when the bread is dropped into the racks.

You provide the bread—and an eerie mechanism does the rest

INSERTING A SLICE untilts the bread rack, whose shorter, vertical leg trips the switch. This closes contacts that send current to the motor. Thus energized, the motor through its pinion and gear rack hauls down the bread carriage, and this in turn stretches the return spring.

WHEN BREAD IS DOWN, the gear rack bottoms on a horizontally pivoted trip lever, pushing its right-hand end under a catch, while lug on gear rack engages a roll-over catch (not shown). The rising left end of the trip lever pushes up a rod that lifts a hinged switch leaf. This opens the motor circuit and closes the heavy contacts that carry oven current. Toasting begins.





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BREAD RACK

RETURN SPRING

SWITCH LATCH

GEAR RACK

CONTACTS

PINION

MOTOR

SELECTOR KNOB

OVEN ELEMENT

TRIP LEG

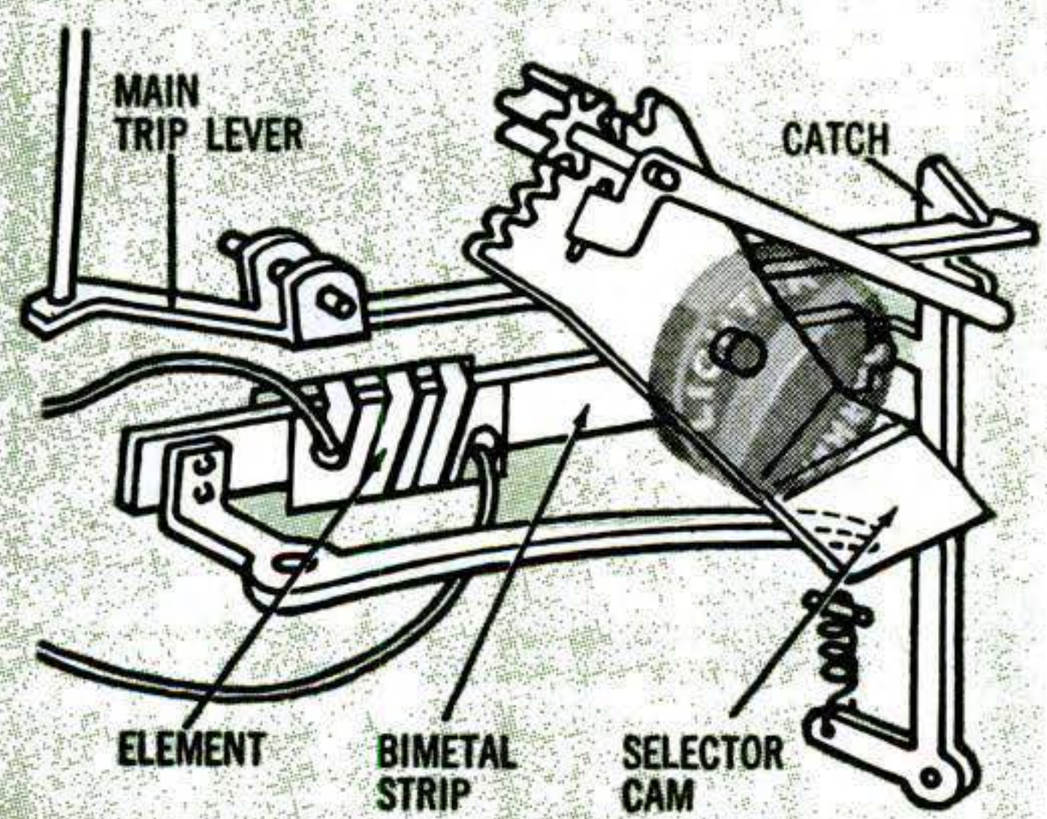
SWITCH ROD

GUIDE SHAFT

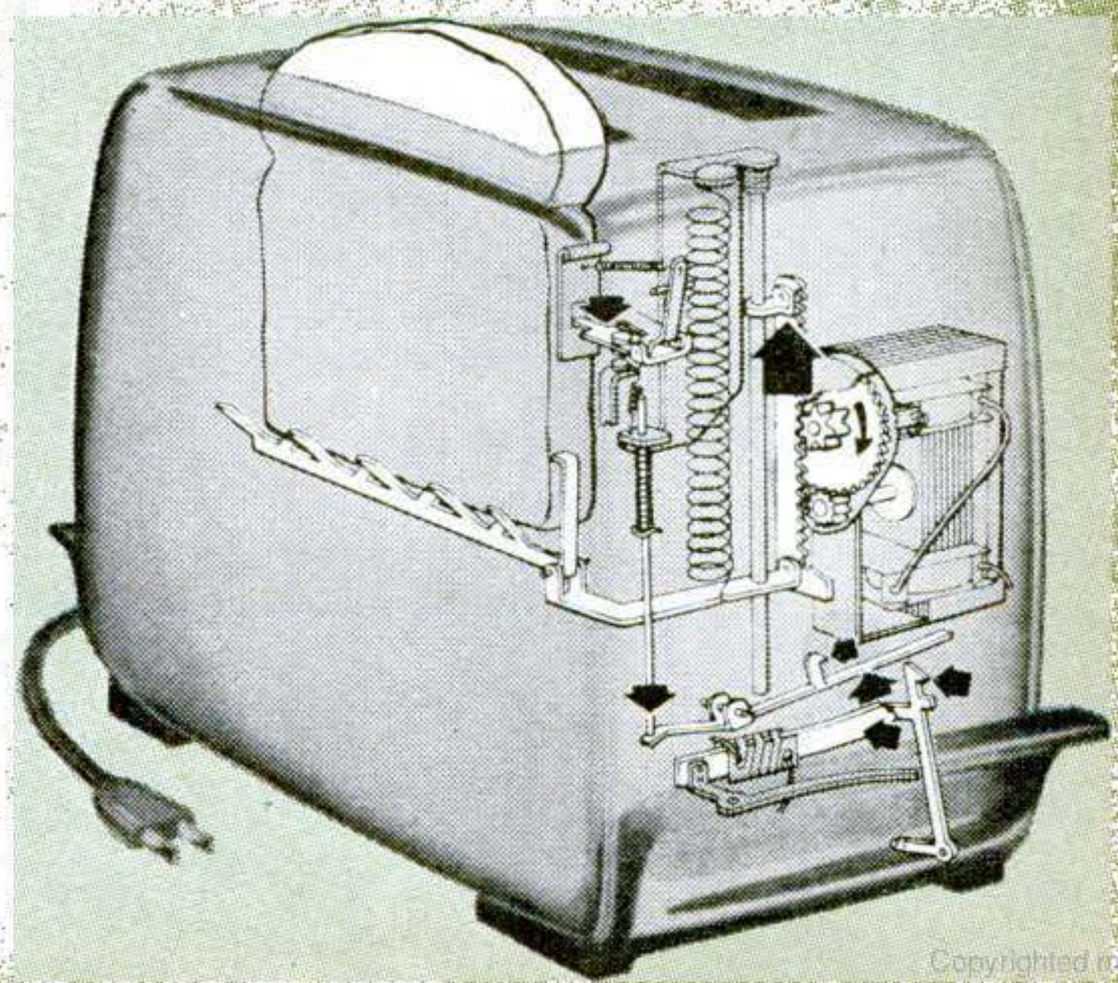
MAIN TRIP LEVER

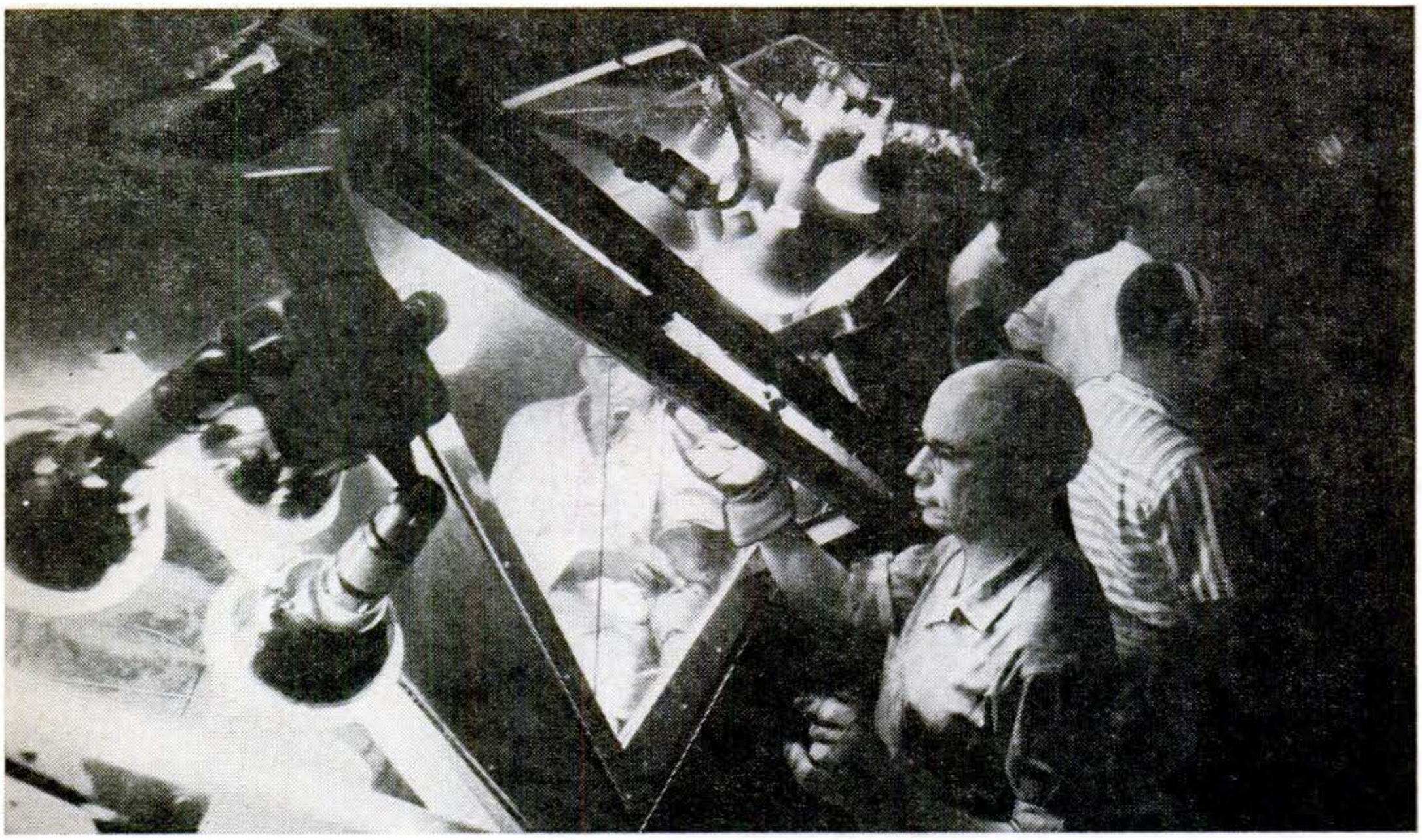
CATCH

AS TOAST BROWNS, heat from a small auxiliary element bends a bimetallic strip until it strikes a stop positioned by your choice of toast color. As simplified below, the strip then moves the latch, frees the trip lever. Actual mechanism is more complex; it first cuts out the auxiliary heater, leaving the ovens on. Cooling, the bimetallic strip bends back, trips the catch.



TOAST RISES as the return spring pulls up the bread racks, cushioned by a ratchet in the reduction-gear case. A coil spring pushes switch rod down, opening oven contacts. Why doesn't the motor pull the toast down again? Because weight of toast, holding rack as below, keeps motor points apart. Toast must be removed, resetting switch, before they can close again.

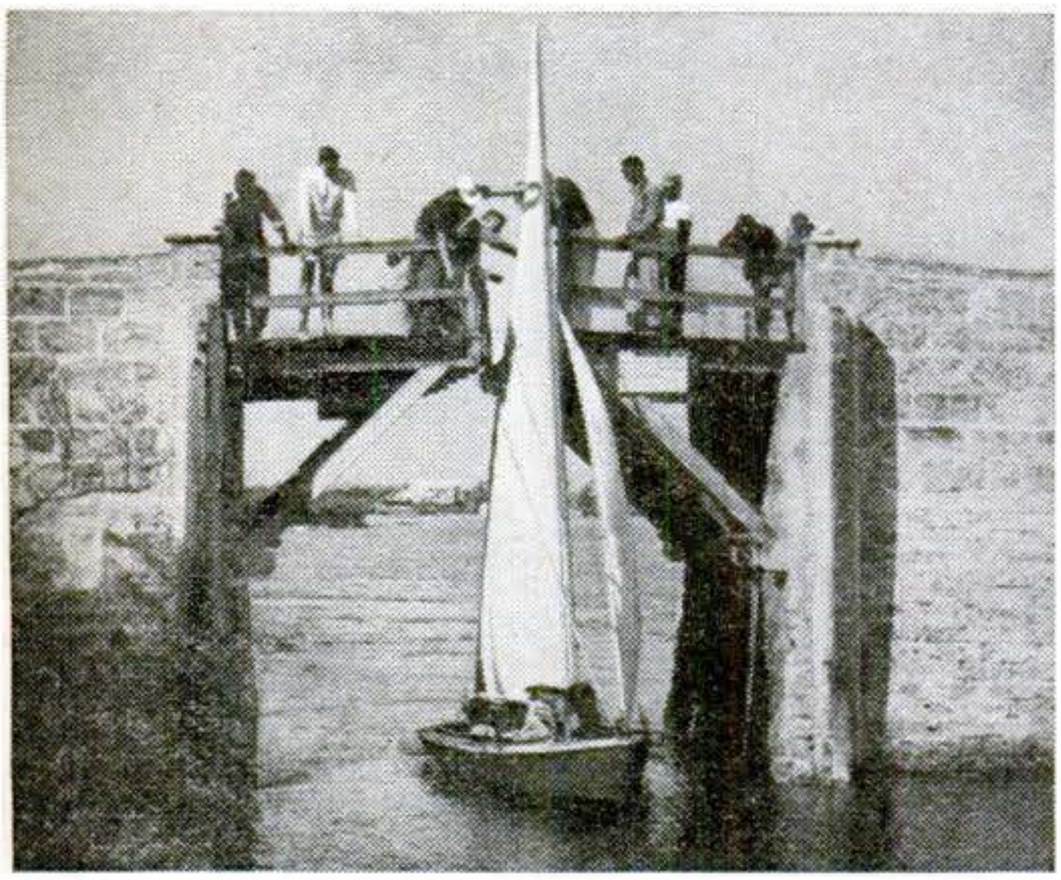




Cooling tomorrow's Mach 3 airliners

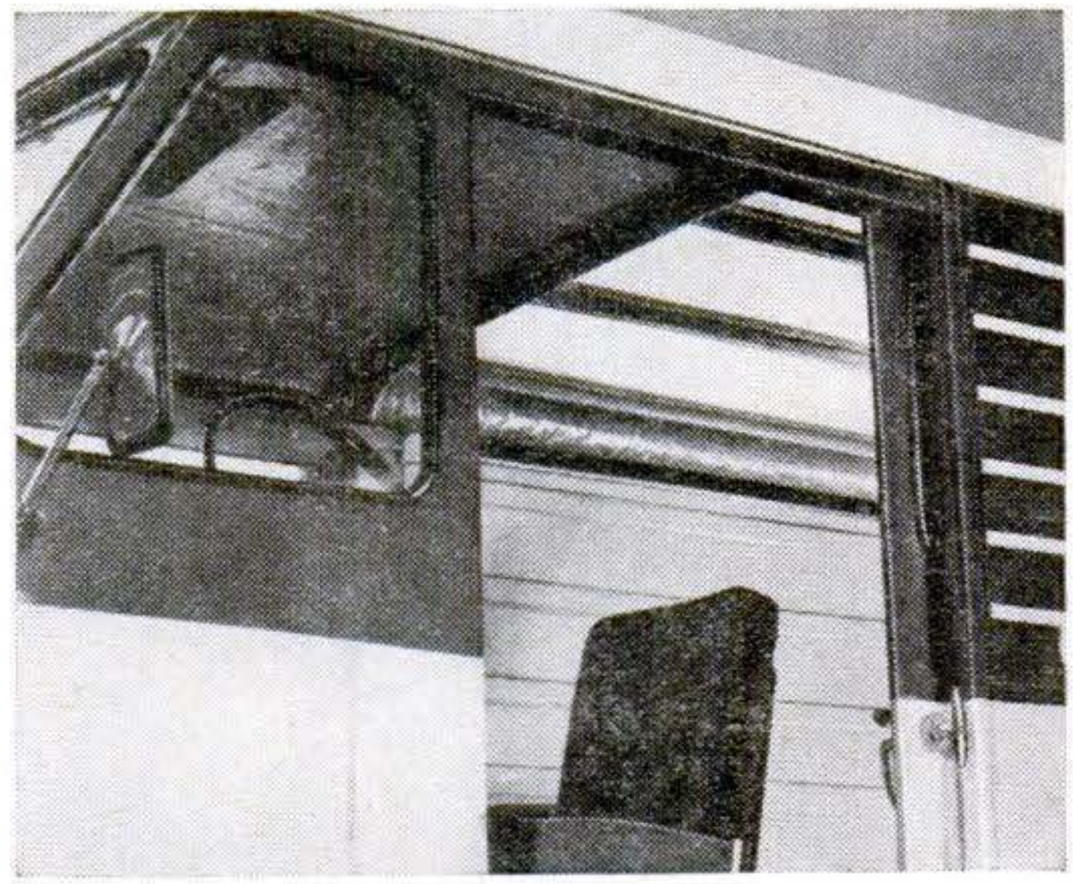
Beyond the glass pane in the picture above are a couple of men who know what aeronauts in 1970 will feel like. Their "cabin" is being subjected to 250-degree heat to simulate conditions inside an airliner of the future going more than 2,000 m.p.h. at an altitude of 70,000 feet. In the foreground and right background are scientists of the Garrett Corp. collecting data on the experiment. The aeronauts aren't suffering—they are being air-conditioned down to a shirtsleeve temperature. Tomorrow's supersonic airliners will have to be super-air-conditioned because a staggering amount of heat will be generated in them by outside air friction, electrical equipment, and ordinary body heat.

Each hour, 300,000 BTU of heat will have to be drained off—or seven times as much as that required to heat a six-room house on a 10-degree winter day.



Tiniest drawbridge

Eighteen inches is the maximum opening of the Somerset bridge in Hamilton, Bermuda, believed to be the smallest drawbridge in the world. Here strollers help a sailor navigate the mast of his dinghy through the tiny opening.



Translucent truck top

Loaders will find plenty of light in this new White truck. It has a translucent skylight in its fiber-glass top that provides diffused daylight in the cargo space. The top is a single assembly, and is removable for replacement.

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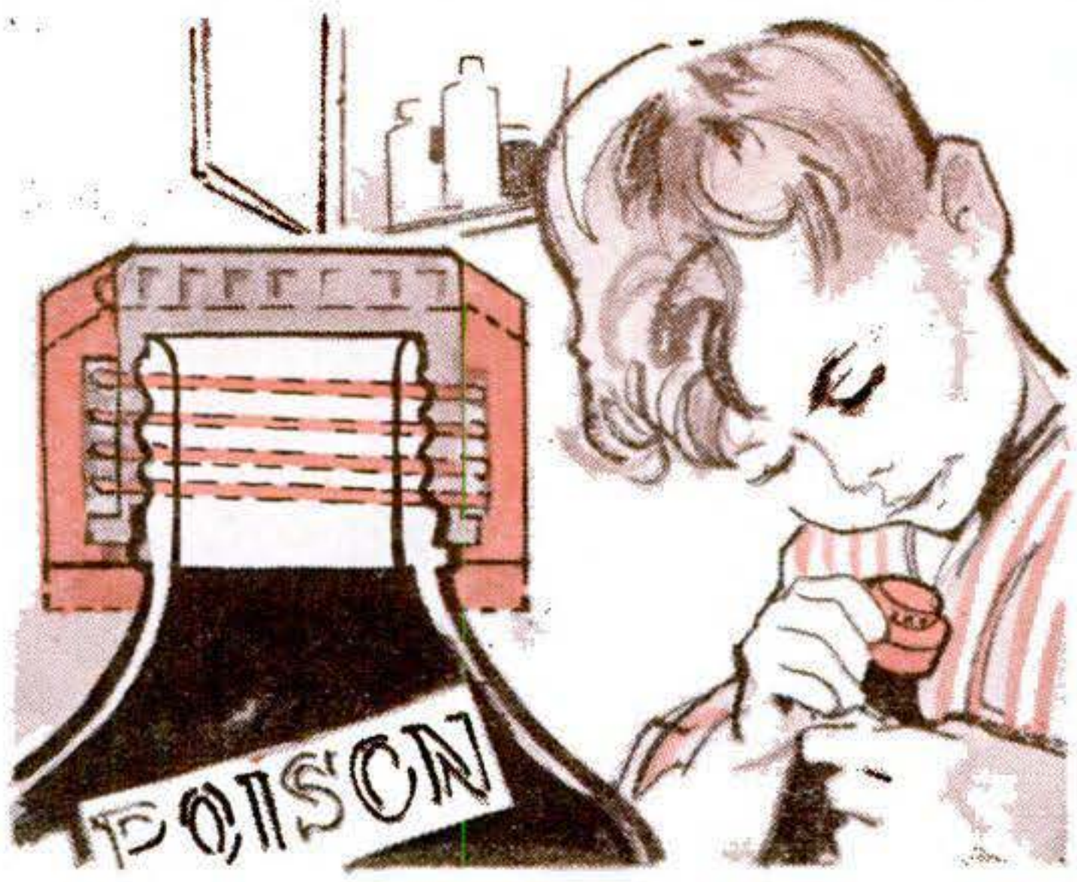
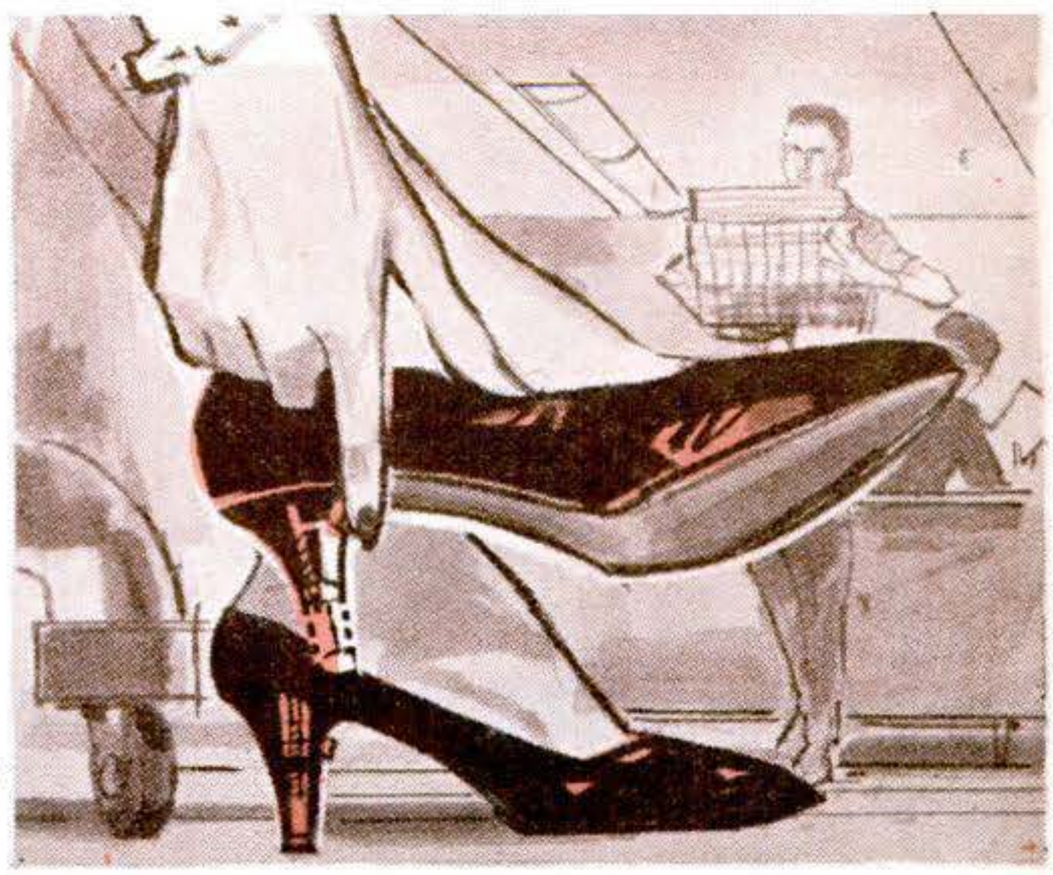
New Ideas from the Inventors

Auto Desk Is a File, Too. Men who use their cars for business might get their paperwork done more quickly and easily with this recently patented desk that rides with them. The writing-surface and armrest panels would lift up—or off—for access to storage sections, and the desk could be lifted out for Sunday driving.

Slide Cap Foils Small Fingers. To unscrew a bottle cap covered by this sliding sleeve, you'd have to align a lug and recess, then squeeze tight to lock the sleeve to the threaded portion. It would keep children safe from poisons, warn grown-ups getting medicine in the dark.

Heel Adjusts for Style or Comfort. Turning a recessed nut against a screw shaft would raise or lower these telescoping heels as much as three-quarters of an inch. The wearer could shorten them for ease when shopping or at the office, then step out taller in the evening.





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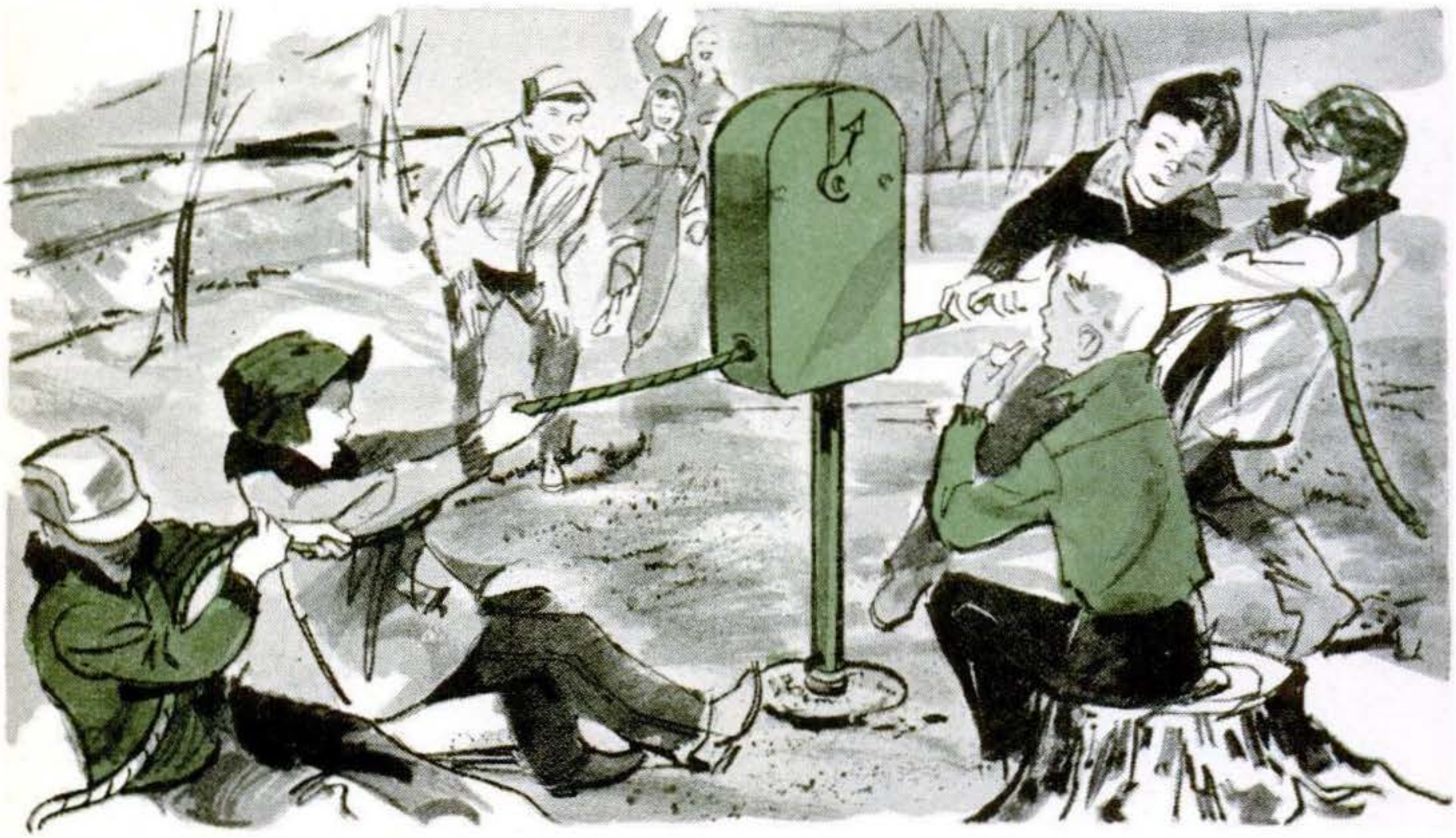
More Inventors' Ideas

Sliding Bridle Stiffens Bristles. You'd have to clean fewer brushes after a paint job if bristle stiffness could be adjusted for broad or fine strokes. A movable bridle on this brush would alter the exposed length—and flexibility—of the bristles. The bridle would snap off for cleaning.

Tire Iron Lifts Wheel. Changing a flat would take less work if you could lever a wheel up to meet the axle. Forked prongs on this tool would slip under a tire and raise it when you pressed down on the handle. A pivoted foot plate would support the lever on soft ground.

Meter Umpires Tug of War. With this "game or exercise" machine monitoring the play, tug-of-war teams couldn't argue over doubtful start or finish lines. Spring-loaded reels would feed out equal starting lengths. Then the stronger pull on either rope end would move a pointer connected by sprockets to the reel hubs.



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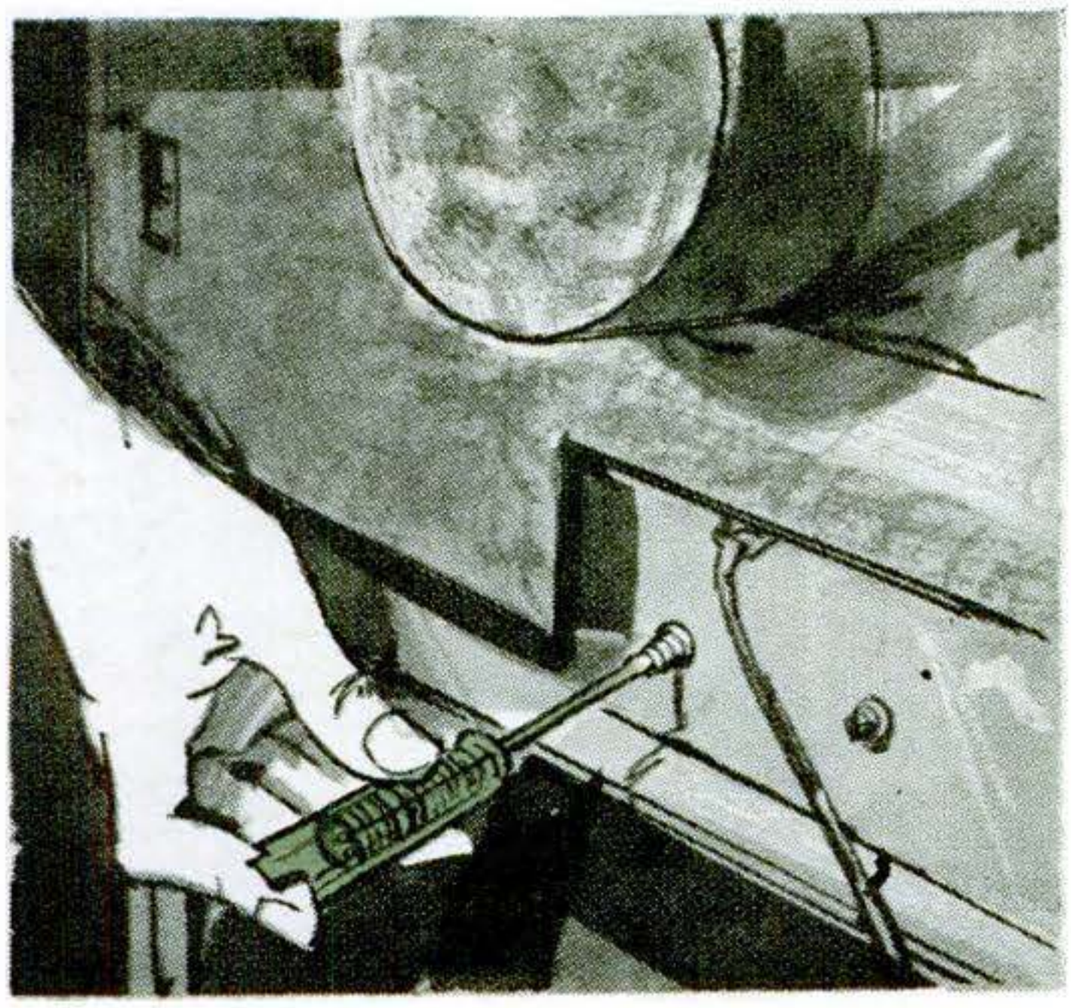
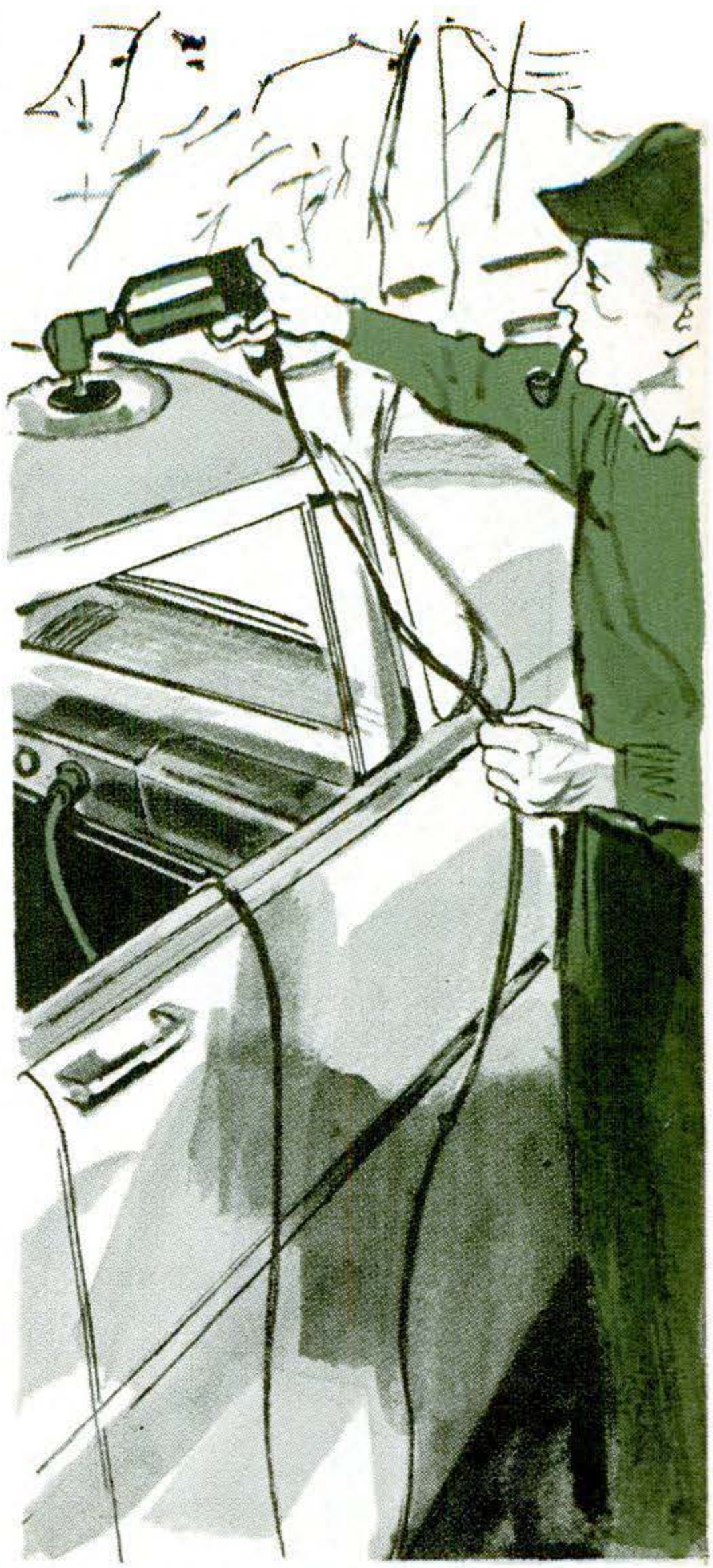
Mudguard Doubles as Sled Runner. Neither snow nor slush would keep a baby in this baby carriage from his appointed rounds. Metal strips pivoted around the wheel axles could be turned down, when necessary, to form sled runners. Spun around, they'd fend off mud.

Tuning Tool Counts Turns. Back-of-the-set adjustments often improve a TV picture, but can sometimes lose it completely. With this alignment tool, however, you'd be able to restore any tunable shaft to its original position. Marked disks would register full or partial turns, and an index on the transparent handle would show net change in direction.





Plug-In Buffer. Here's a wax polisher that works off the car's cigarette-lighter socket. With no extension cord to tie down the car, you could move it into the shade to work. A gas-pedal hold-down would be supplied with the kit to keep the battery charging as you buffed.

The following patents have been issued on these inventions: **Car desk**—*No. 2,934,391 to F. N. Bohnett, Santa Barbara, Calif.;* **Bottle safety cap**—*No. 2,816,677 to F. A. Allan, Arlington, Va.;* **Adjustable heel**—*No. 2,934,840 to Marion Mistarz, Oak Park, Ill.;* **Brush with bridle**—*No. 2,874,399 to Solomon Friedman, Brooklyn;* **Tire iron**—*No. 2,815,877 to P. R. Marshall, Los Angeles;* **Tug-of-war-meter**—*No. 2,934,342 to F. M. Tenney, Decatur, Ill.;* **Carriage runners**—*No. 2,817,536 to W. R. Taggert, Worcester, Mass.;* **TV tuning tool**—*No. 2,817,985 to A. C. Capelle, Bradenton, Fla.;* **Auto buffer**—*No. 2,904,805 to B. V. Dardig, NYC.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

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The Biblical sign might have been

What Was the Star

By Robert S. Richardson Associate Director Griffith Observatory

AT CHRISTMASTIME astronomers are often asked, "What was the star of Bethlehem?"

About all an astronomer can do is shake his head regretfully, say that no such star as the star of Bethlehem now exists, and that there is no scientific evidence of its existence at any time. But he might also cautiously admit that there are a few ways in which the appearance of such a remarkable object as the star of Bethlehem might be explained. "For example, suppose that we assume—" and he proceeds to discuss some of the things that might have happened. Let us follow his discussion and see what some of these possibilities are.

It is related that the Magi had seen a star in the east that heralded the birth of a King of the Jews. They traveled to Jerusalem, told Herod of the star, and wished to know where He was that they might worship Him. Herod sent them to Bethlehem because it had been prophesied that the Messiah would be born in the city of David.

"When they had heard the king they departed; and, lo, the star, which they saw in the east, went before them, till it came and stood where the young child was.

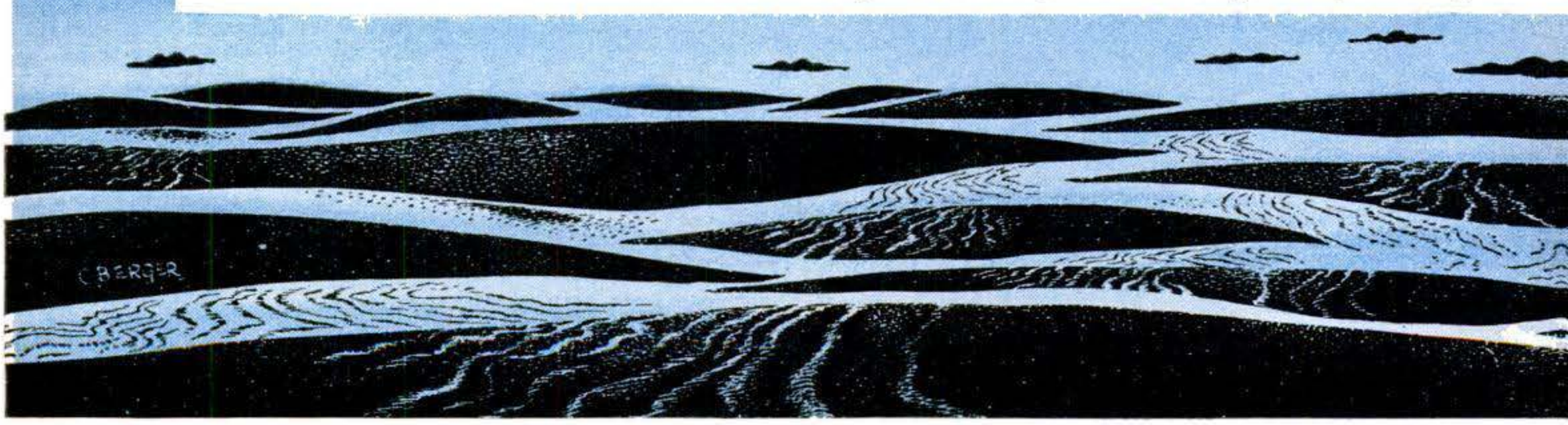
"When they saw the star they rejoiced with exceeding great joy."

The Magi worshiped the child and gave Him gifts, and then, warned that Herod sought to destroy Him, went by another way to their own country.

There is no other mention of the star in the scriptures or in other historical accounts.

In seeking a rational explanation, it must be remembered that the Chaldeans were assiduous observers of the heavens, so that the positions of the fixed stars and the motions of the planets were a familiar

This article is from a new book, "The Fascinating World of Astronomy"



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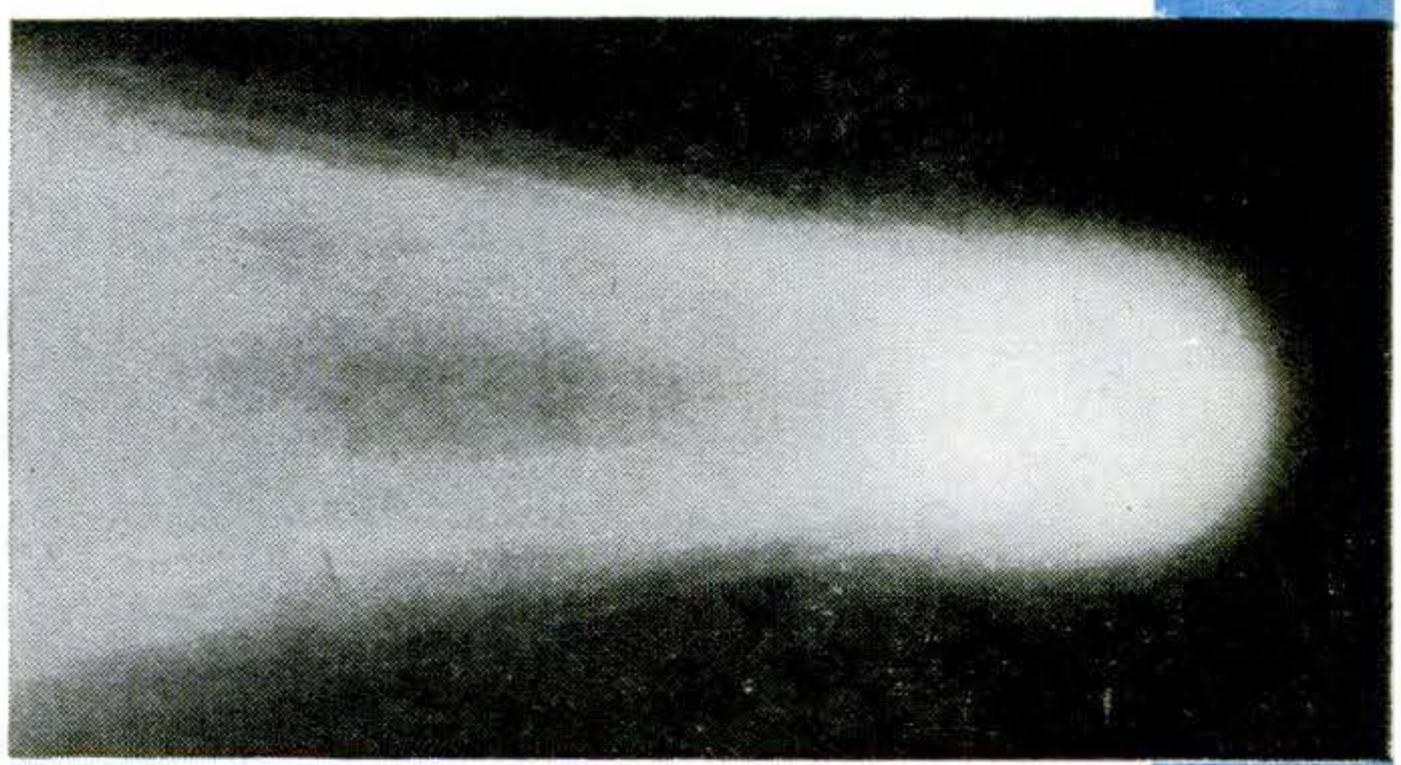
overlapping planets, a new star, or a fiery comet

# of Bethlehem?

story to them. Indeed, there is every reason to believe that the ancients were much better acquainted with the constellations than are the people of today, who can seldom get a good look at the night sky because of artificial illumination. The Chaldeans would never make the obvious blunder of mistaking a bright star such as Sirius for the sign for which they were waiting, or even one of the bright planets, Mars, Jupiter, or Venus. We must look for something very unusual in the sky, some exceptional and awe-inspiring event that occurred about the time of the birth of Christ.



The head of Halley's comet. Mount Wilson and Palomar Observatories photo.

Here we get into trouble at once, for history is so vague and confusing on this point that it is impossible to fix the birth with any certainty. But it is probable that 5 B.C. would not be greatly in error. (Many people may ask what is the matter with December 25, in the year A.D. 1. Our use of the year of the birth of Jesus as the era from which to reckon time came from a suggestion by the learned Roman monk Dionysius Exiguus, who died in A.D. 556. He computed the date of the birth to be 754 A. U. C. [*ab urbe condita,* time measured from the founding of Rome] and although this is now known to be wrong, the system has become so firmly established that noth-

[Continued on page 232]

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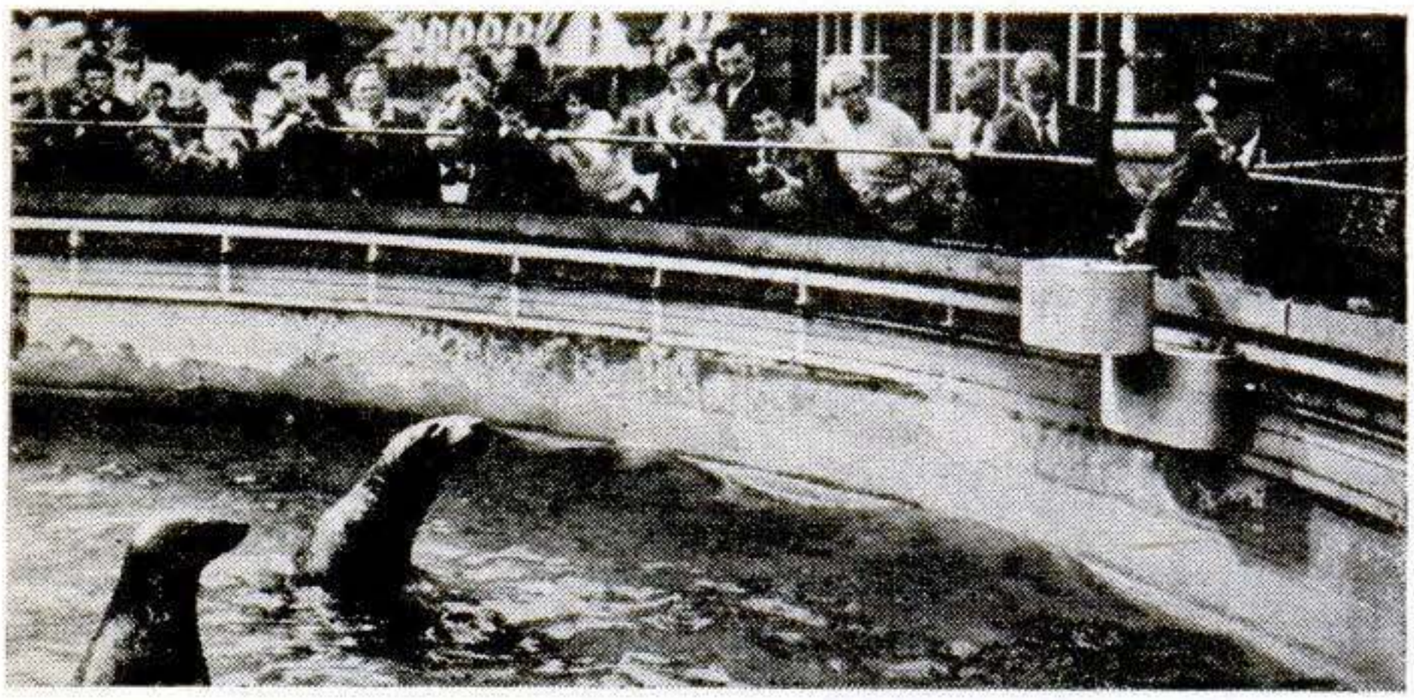
Belt records space reactions

A special belt is helping the Boeing Airplane Co. test human reactions to simulated spaceship conditions. While the subject undergoes depressurization and extreme heat and noise simultaneously, miniaturized medical instruments in the belt record heart electrical impulses and sounds, brain waves, and body heat.

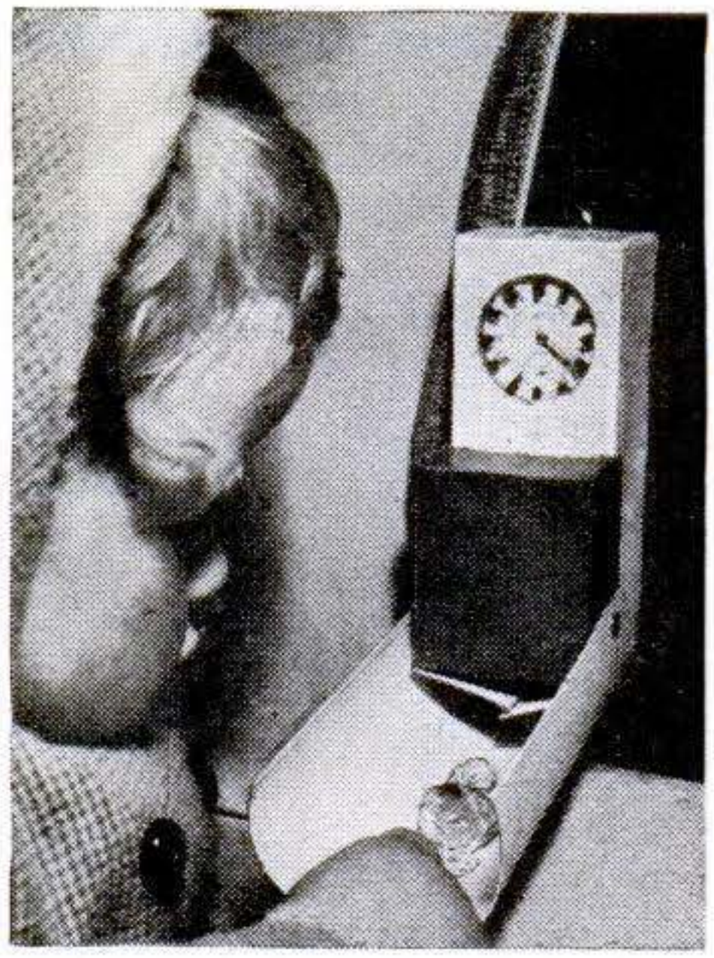


Electric feeder keeps seals hopping

Seals at the London Zoo are learning to eat and stay slim—with the help of an electric fish dispenser. The device circles the pool's edge and ejects a fish each time the keeper presses a button, giving the animals exercise and entertaining the watchers.

Gas gun

Sixty bullets can be fired by this gas-powered sport rifle without reloading. And 1,200 shots can be fired before the gun must be recharged from a CO_2 bottle. Austrian made, it also comes in a military model used by the Austrian army.



Dispenser gives candy to baby

How to keep baby quiet in the carriage while mamma shops in the store has been solved with this British-made automatic candy dispenser. It's fitted with a timer that releases the sweets at set intervals.

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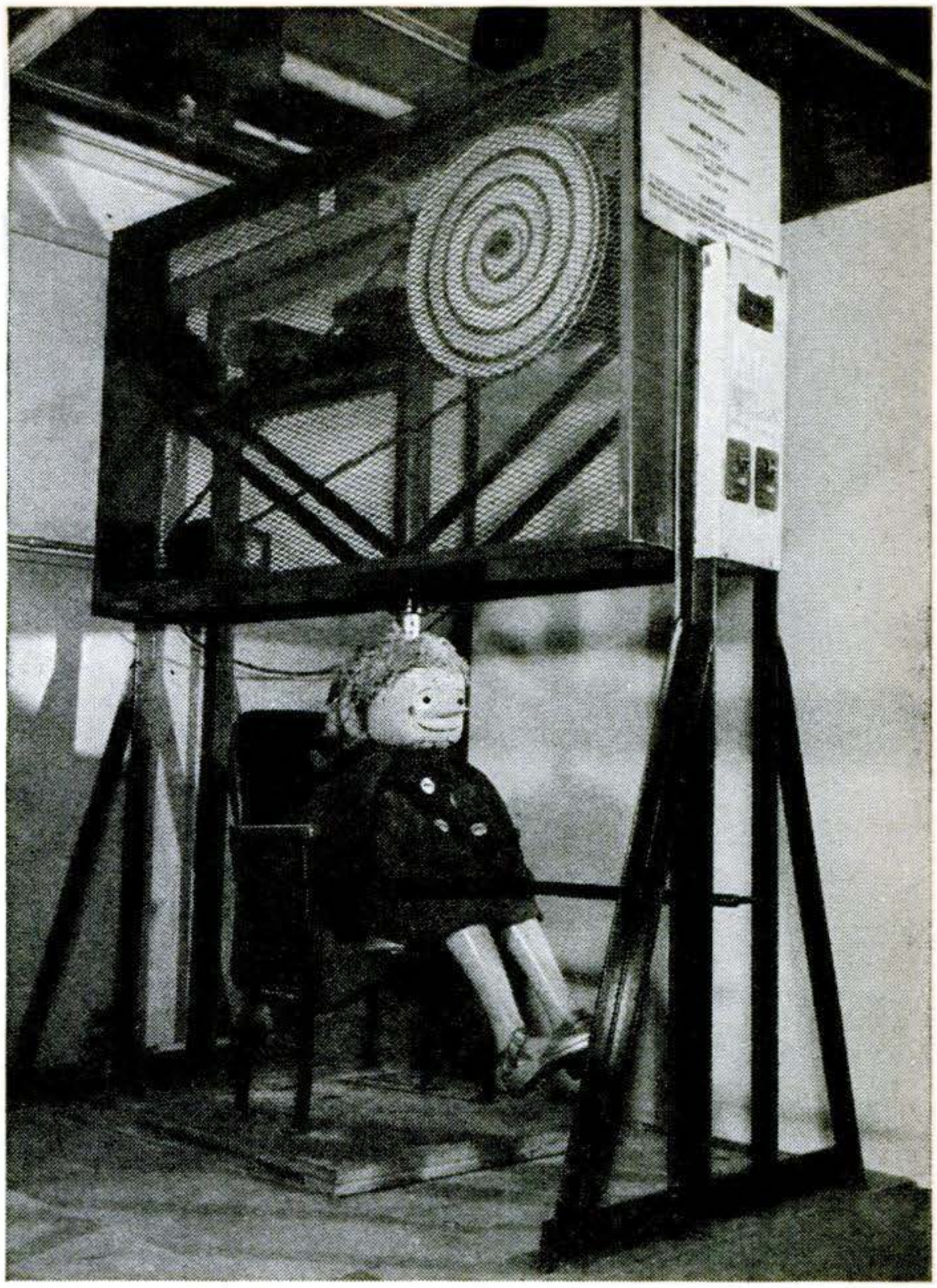
BOTTOM of Squirming Irma, shaped like a human's, is made to roll, twist, slide, shift, and toss like a fidgety teen-ager weighing 130 pounds.

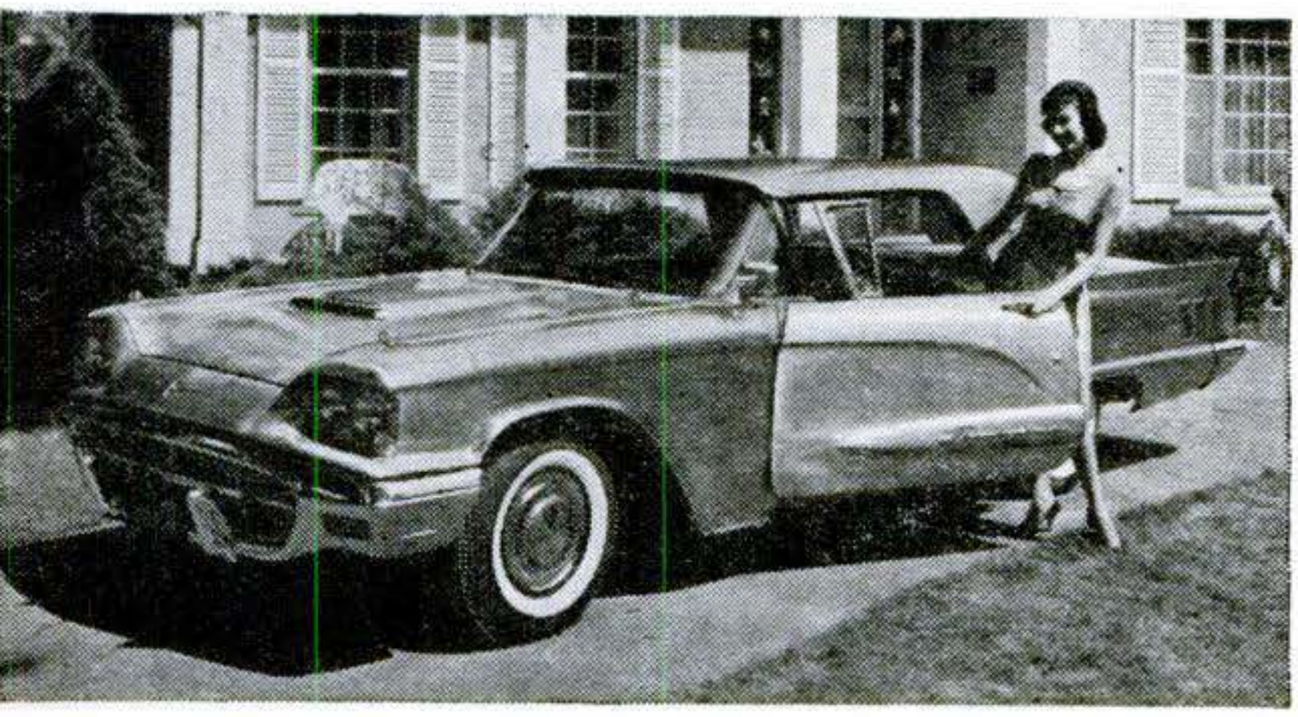
Squirms test movie seats

The strange-looking mechanical device shown here has a name: Squirming Irma. Irma's job is to test seats manufactured for theaters, schools, and buses. Irma makes her tests for the American Seating Co., Grand Rapids, Mich.

She's designed to simulate the wear and tear caused to seats by people, particularly young people prone to wriggle.



CLOTHED IRMA tests seat-cover wear. Fifty hours of squirming equals what a school seat will get in two years.



Stainless-steel car

The stainless-steel body of this Thunderbird isn't painted or protected in any way—and it's expected to last indefinitely. The car was built for the Allegheny Ludlum Steel Corp., Pittsburgh, to show the durability and good looks of stainless steel. Several stainless 1936 Fords are still rolling and still look good.

One-wheel tunnel scooter

This experimental catwalk car, tested recently in New York's Lincoln Tunnel, lets policemen cover their beats more quickly. Weighing 550 pounds, the aluminum and plastic car rides on one wheel and is guided by a side rail. It goes in either direction, does up to 30 m.p.h. powered by an eight-hp. gas engine.

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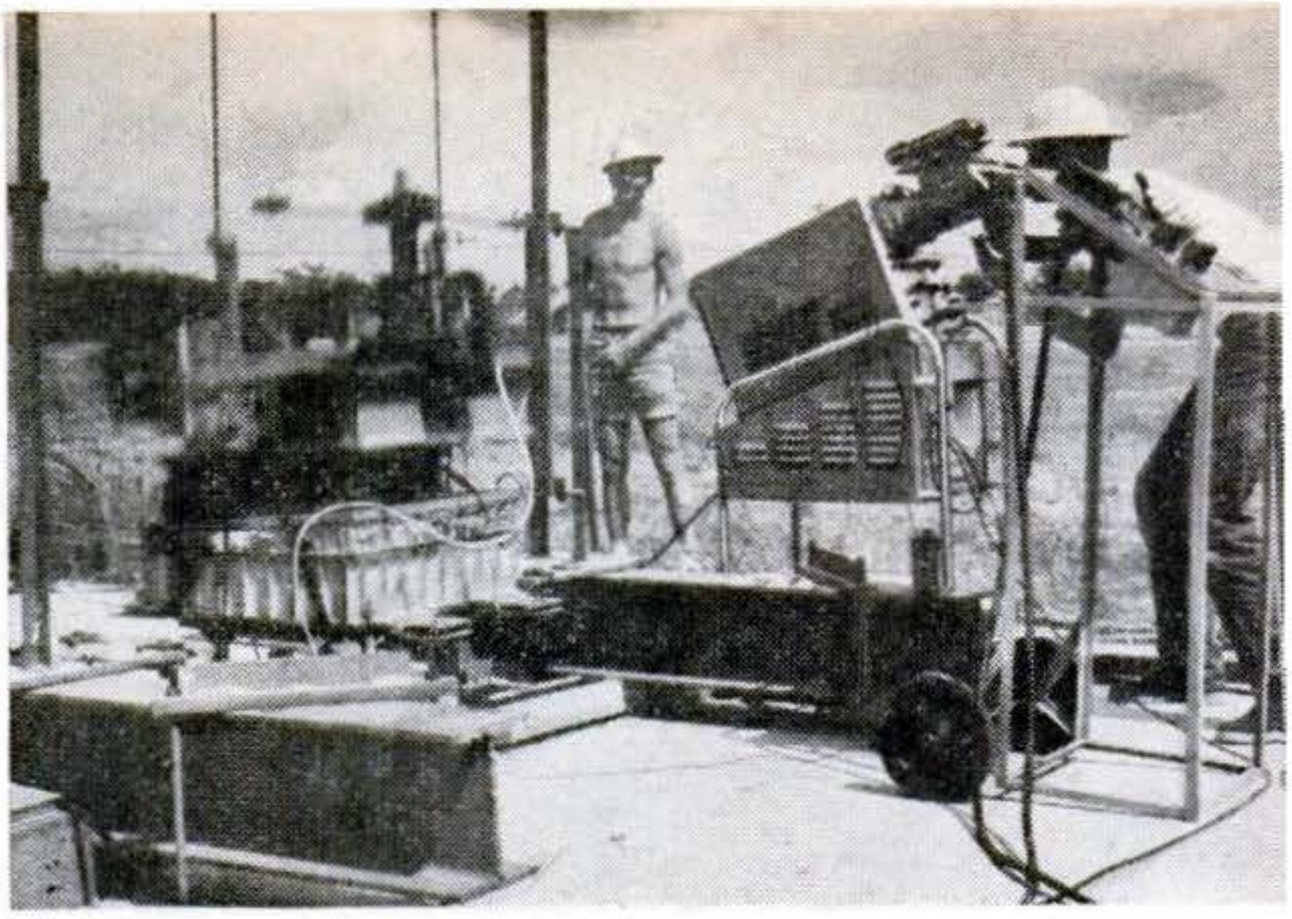
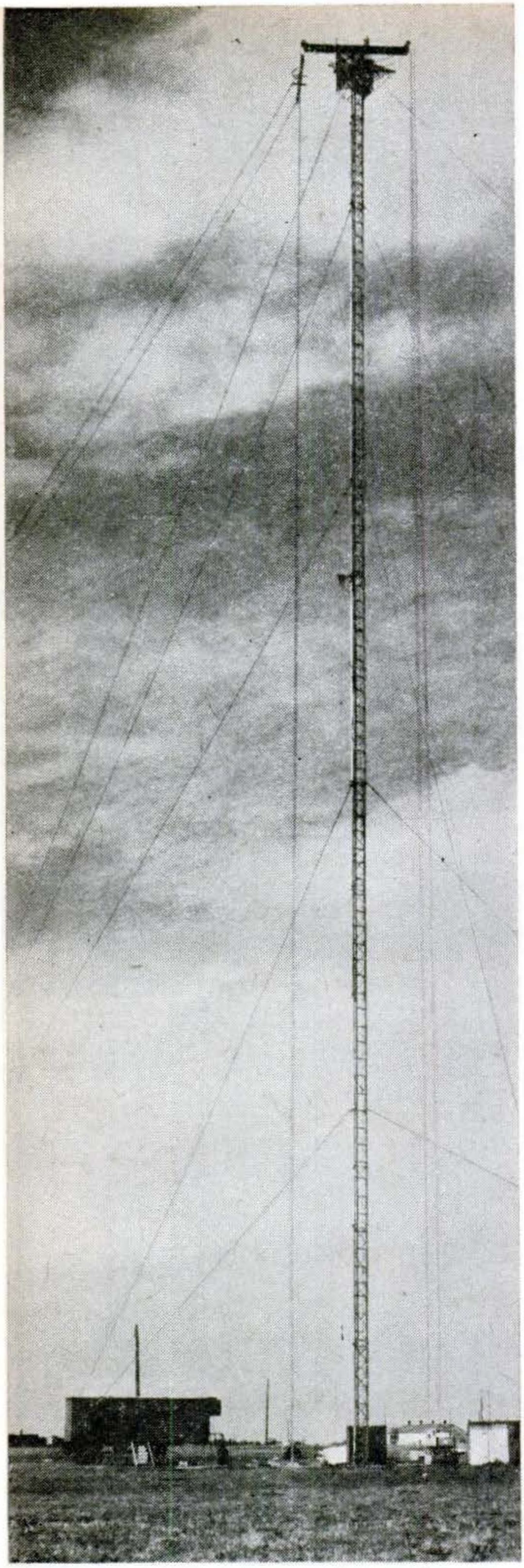
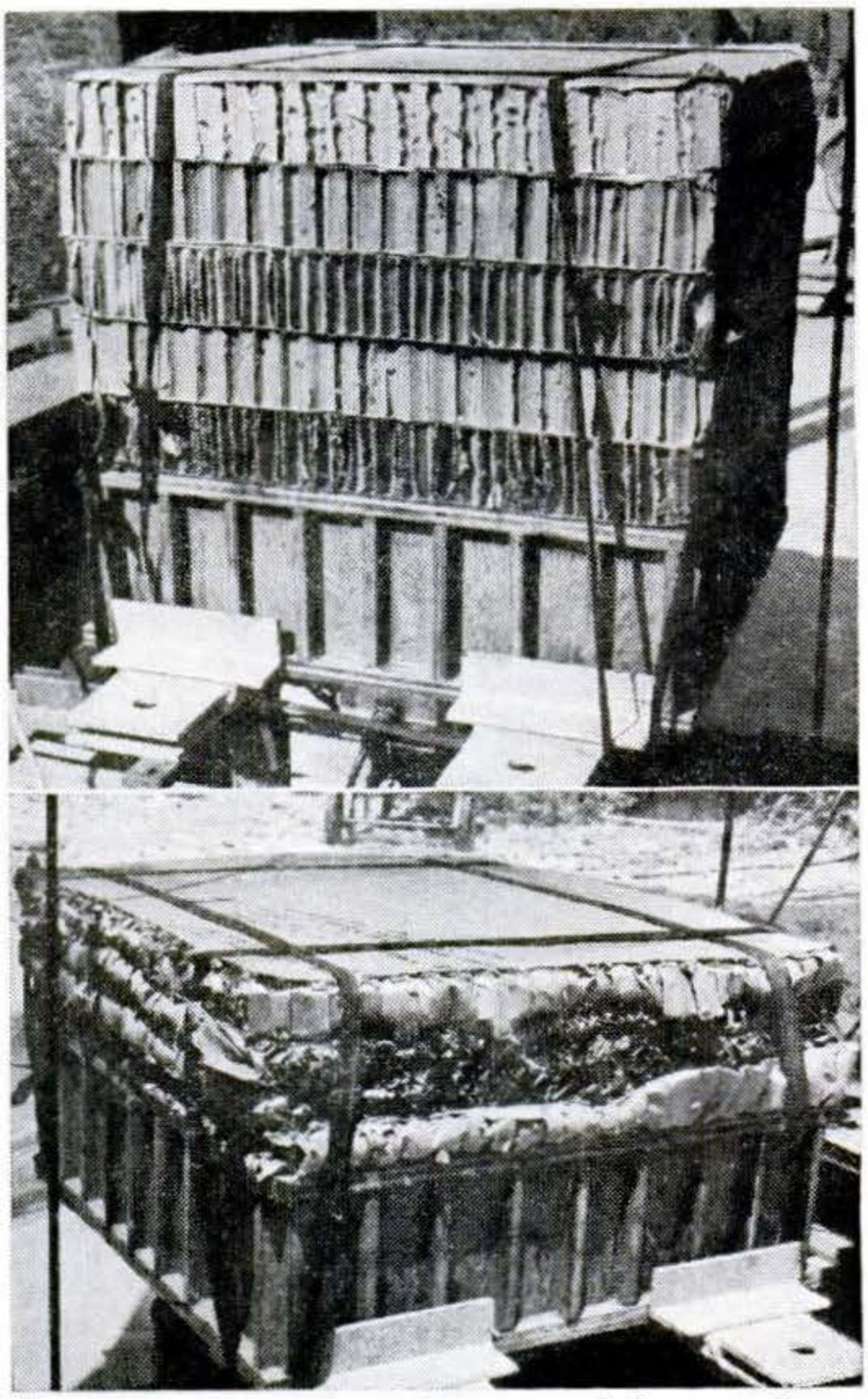


A 230-POUND BLOCK of laminated wood slams down from 280 feet. Polaroid camera films stress and strain curve plotted by an oscilloscope. Slow-motion movies also record the drop.

Army Air-Drops Supplies onto Paper Cushion



TOWER HOISTS TEST LOADS and drops them onto a force-measuring plate at its base. Cables guide loads. Instrument-carrying van is at left.



IMPACT EFFECT: Upper honeycomb has not been hit. Bottom stack is crushed to 40 percent of original volume. Rubber straps secure stacks.

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FELT SHOCK PADS, center, are ones now used as air-drop cushions. To right are crushed and whole honeycomb samples. Man at right is holding unexpanded honeycomb without facings.

WITH the help of a paper-honeycomb pallet, big Army trucks are being taught to drop 1,000 feet out of the sky —and land mobile as a kitten that just four-footed it off a couch.

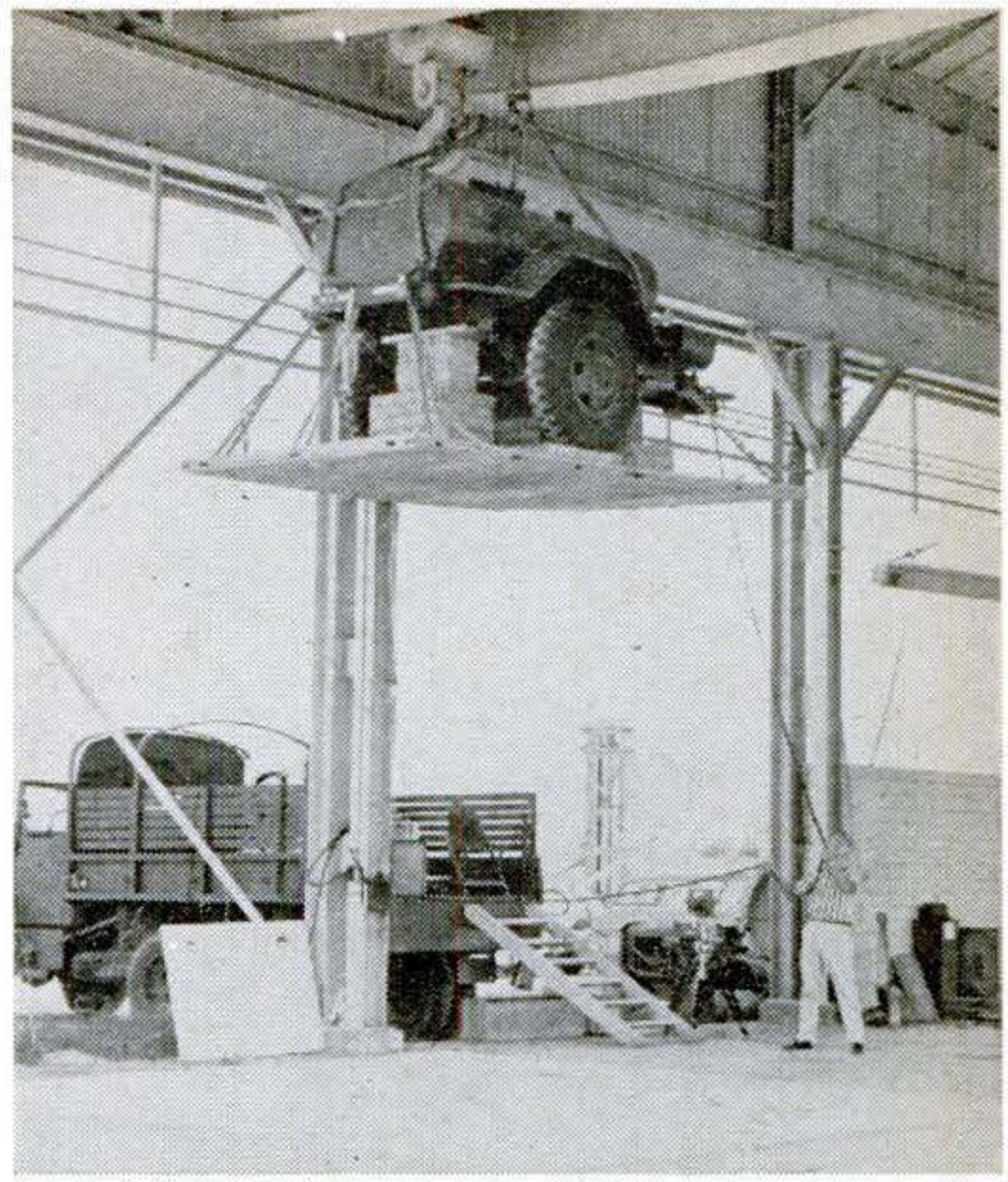
To make sure the lesson takes, engineers at the University of Texas Balcones Research Center, working under an Army contract, triple-check with oscilloscopes, slide rules, and a 280-foot drop tower.

The honeycomb material is the Army's new solution to the heavy losses—estimated at as much as 50 percent—of parachute-dropped equipment during World War II. It can absorb 95 per cent of the crushing impact of a truck parachuting 1,000 feet. Properly packaged, it also can gentle the landing of a jeep, a water tank, a high-powered artillery piece, even a paratrooper.

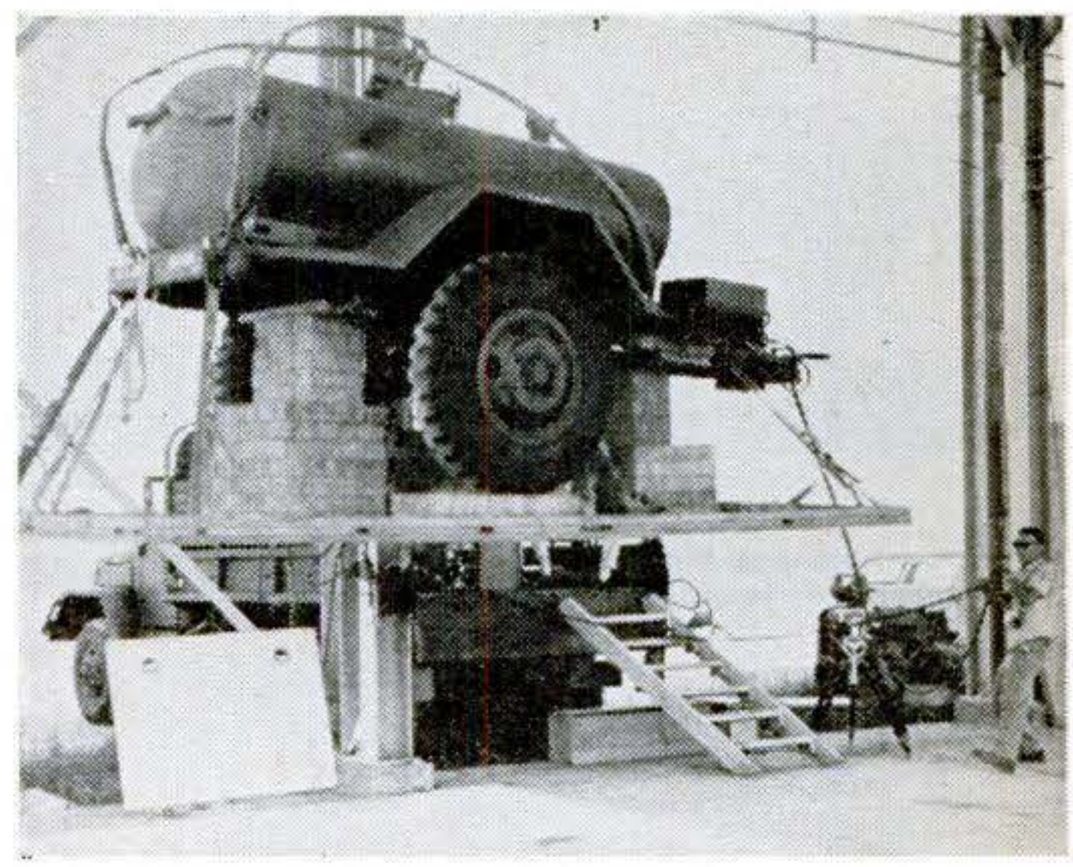
Here's an example of what the sandwich can do to shock:

Five three-inch layers of honeycomb are stacked on a force-measuring plate at the base of the drop tower. The release button is pushed, and 230 pounds of laminated wood whine 280 feet down the cables. The wood hits the honeycomb with a 75,000-pound force, but doesn't splinter as might be expected. The sandwiches absorb the shock with a slightly explosive *whoof*.

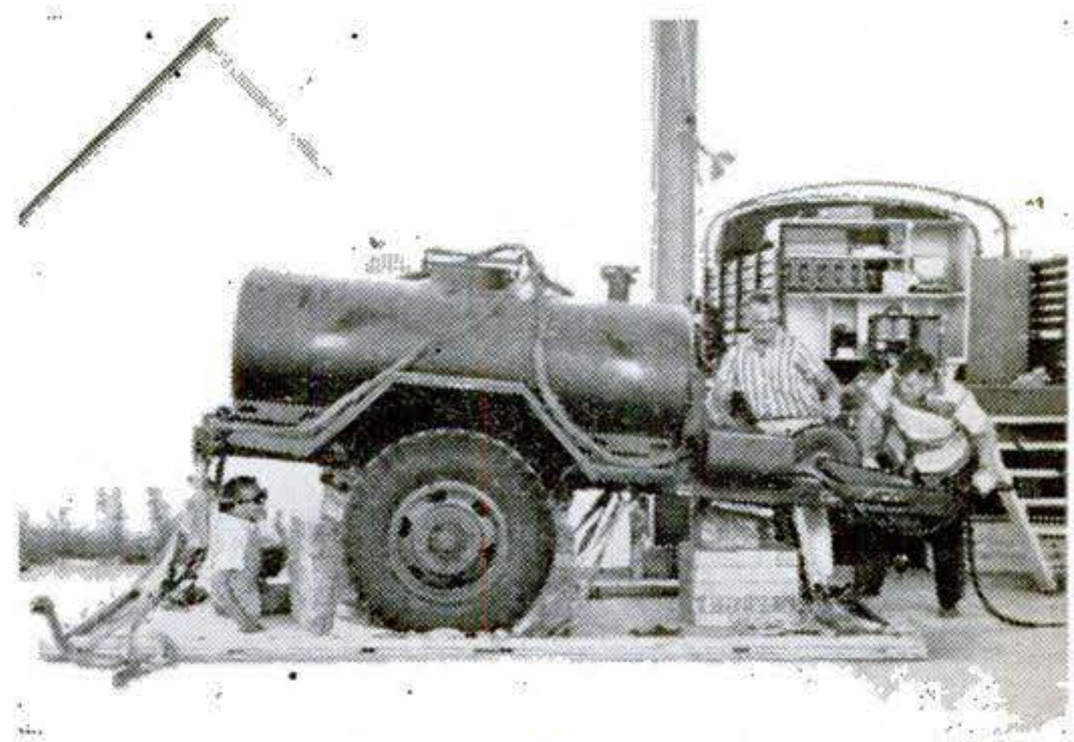
Eight years of testing in the lab and at the tower have shown that the honeycomb has still another advantage: It reduces cost of air-drops by allowing use of smaller parachutes.—*Marj Wightman.*



WATER-TANK TRAILER is raised 14 feet. Impact velocity from this height is about the same as that of an actual parachute delivery.



AN INSTANT AFTER ITS RELEASE, trailer still is about five feet from impact. Cables run from front of trailer to the instrument van.



TECHNICIANS EXAMINE TRAILER for damage just after impact. Honeycomb cushioning is crushed to about 50 percent of original volume.

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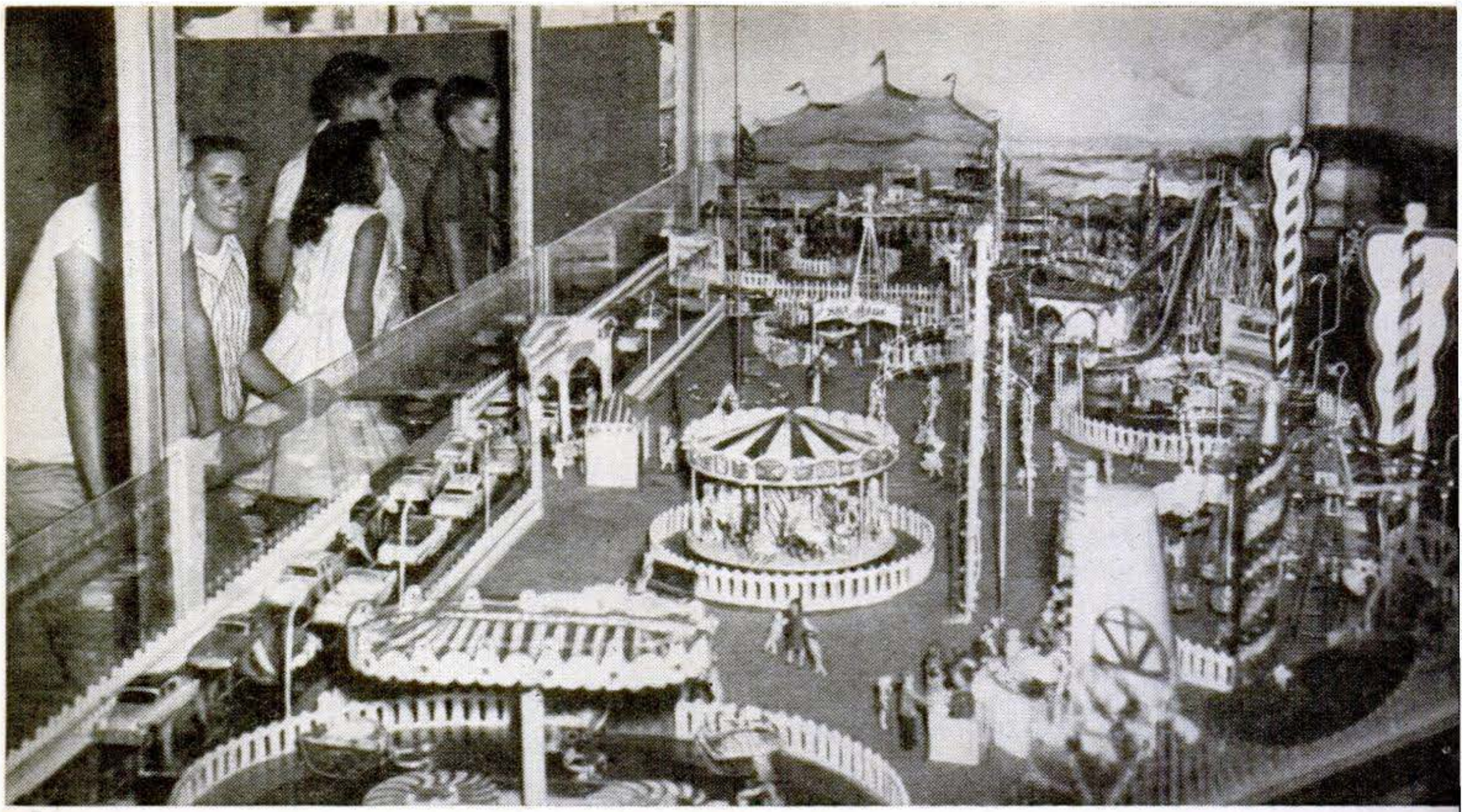
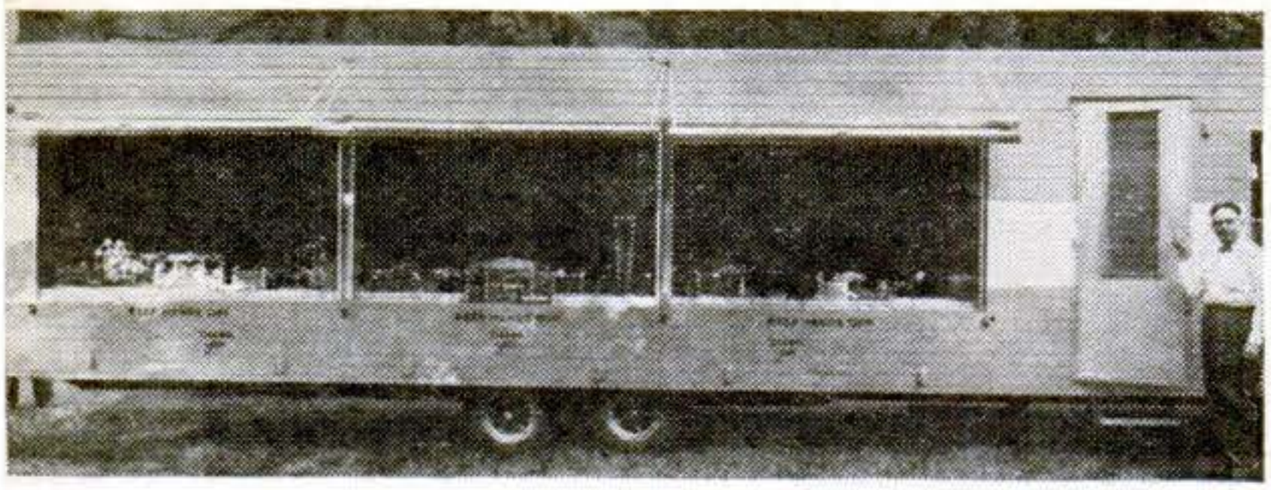




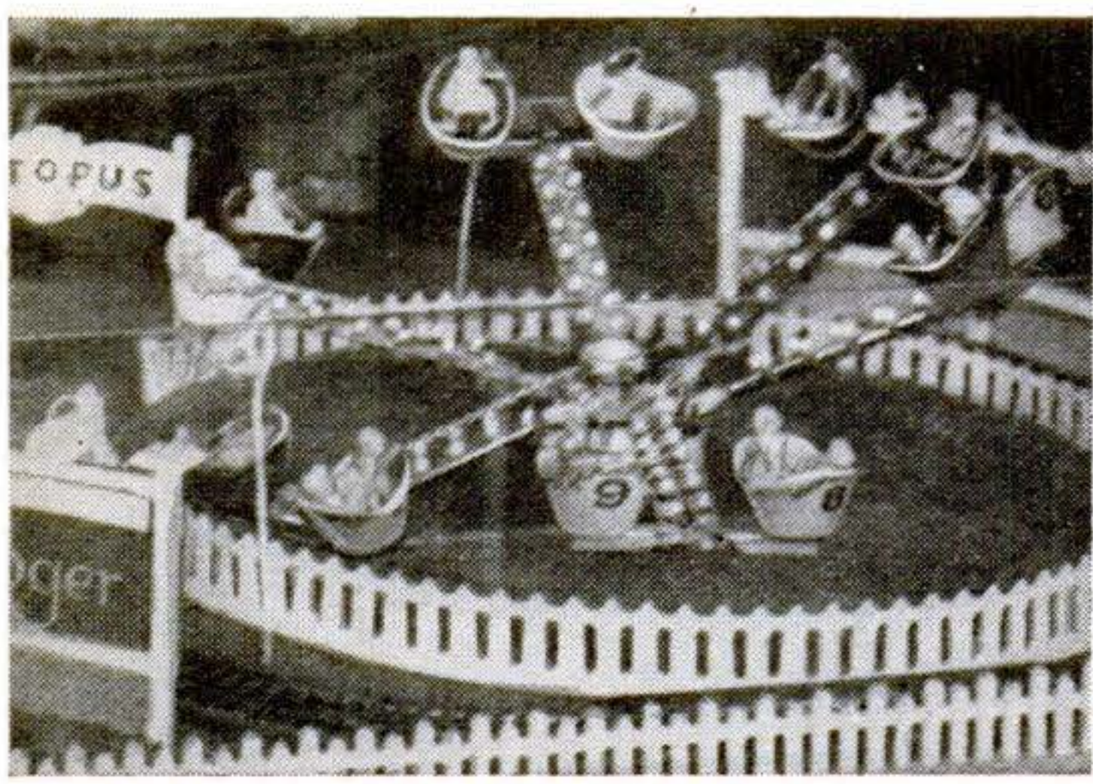
FLEA-POWER MOTORS—36 of them —specially designed by Speedway Div.-Thor power the rides. Built in 1928, merry-go-round still runs.

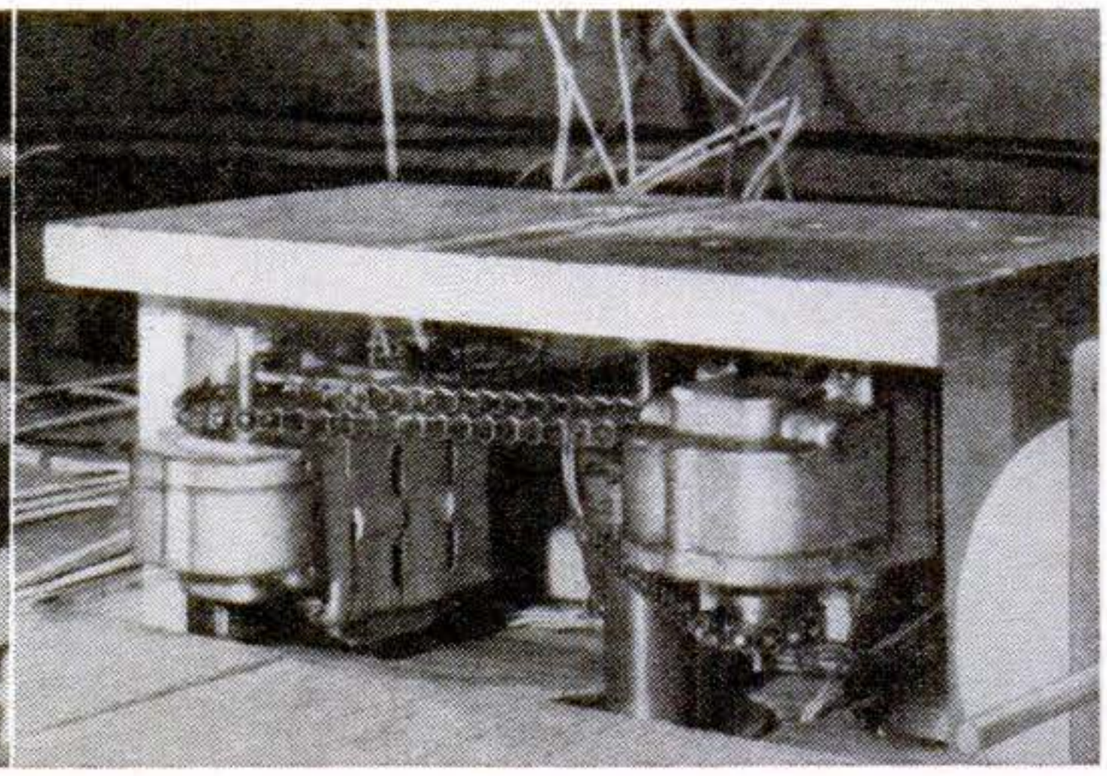
CARNIVAL RIDES TO FAIRS in a trailer that is its permanent display case. Picture windows protect against damage by children.

He built his own miniature carnival

A flick of the switch, and 1,200 flashlight bulbs light up, 10,000 tiny components go into action, and 500 make-believe merrymakers seem to have the time of their lives. It's Fred M. Gross Sr.'s amazing miniature carnival.

Gross, who lives in Ashland, Ky., began his unusual hobby 32 years ago with the construction of a scale-model merry-go-round. His exhibit is now valued at $50,000. It's displayed at fairs and special occasions throughout the country.





OCTOPUS RIDE with its gyrating arms (left) is bright with lights. It has two interdependent motors (right). One turns the arms while the other, timed to start and stop eccentrically, raises and lowers them. Twin-motor setups also power the tilt-a-whirl and the whip.

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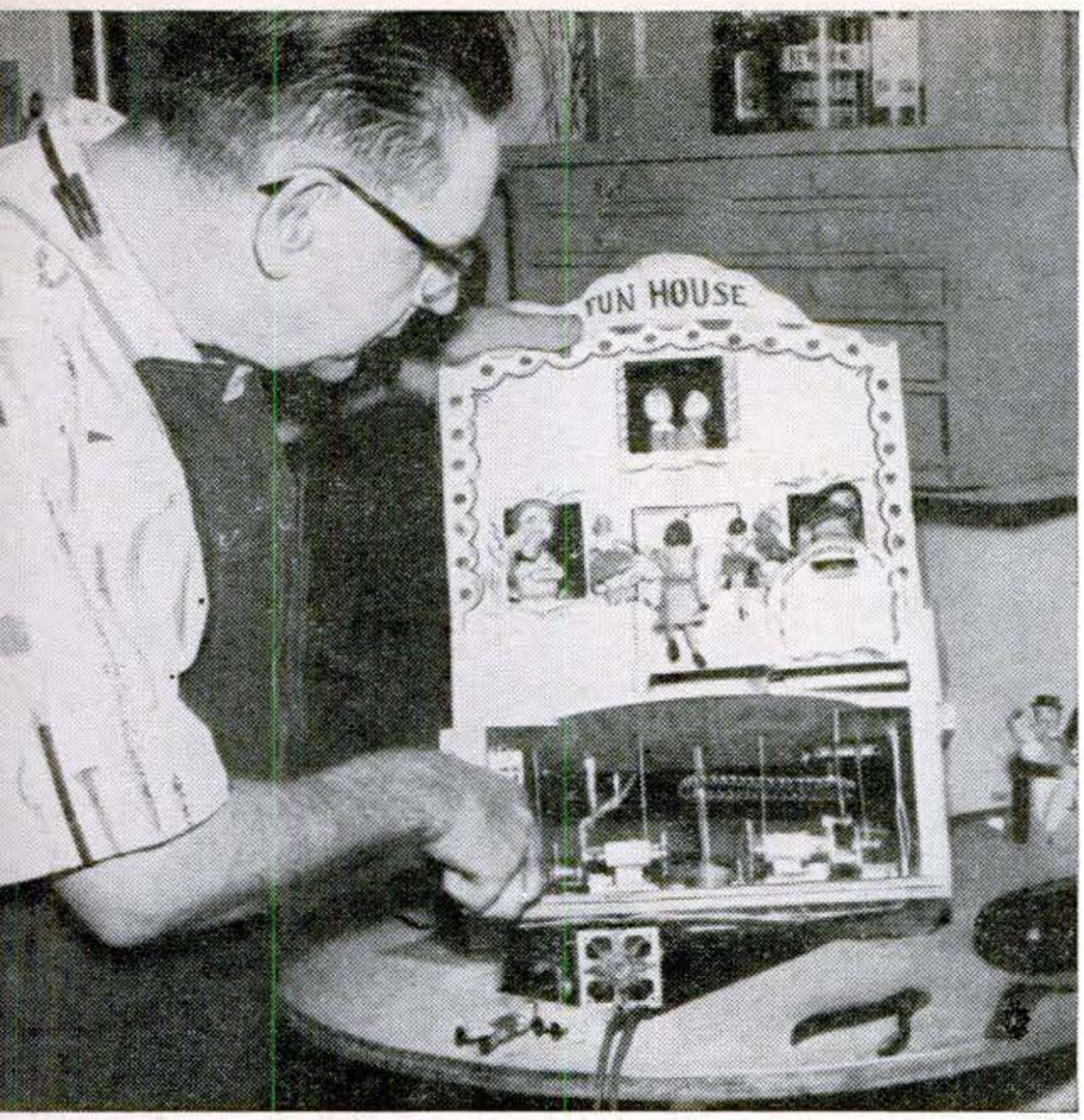
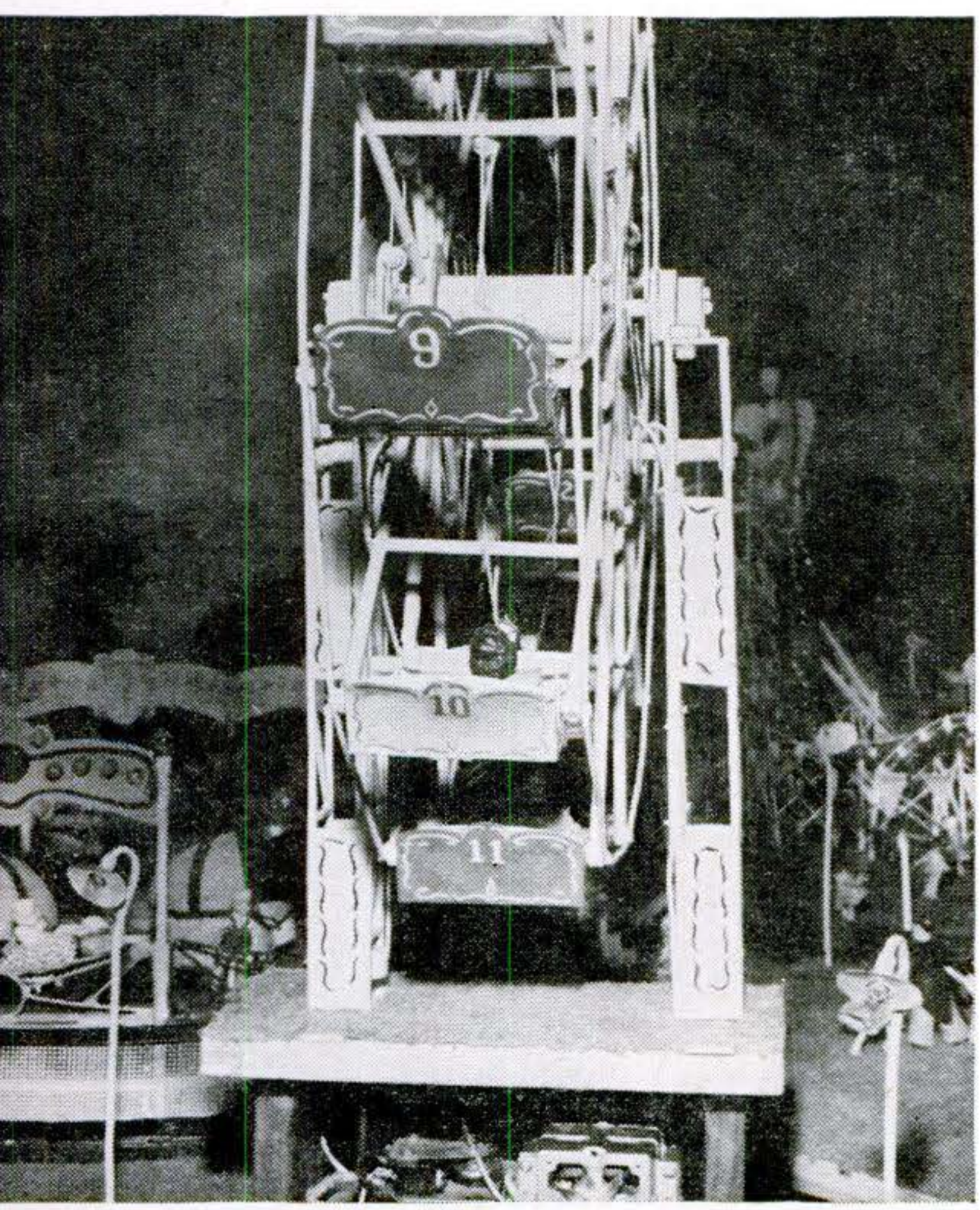
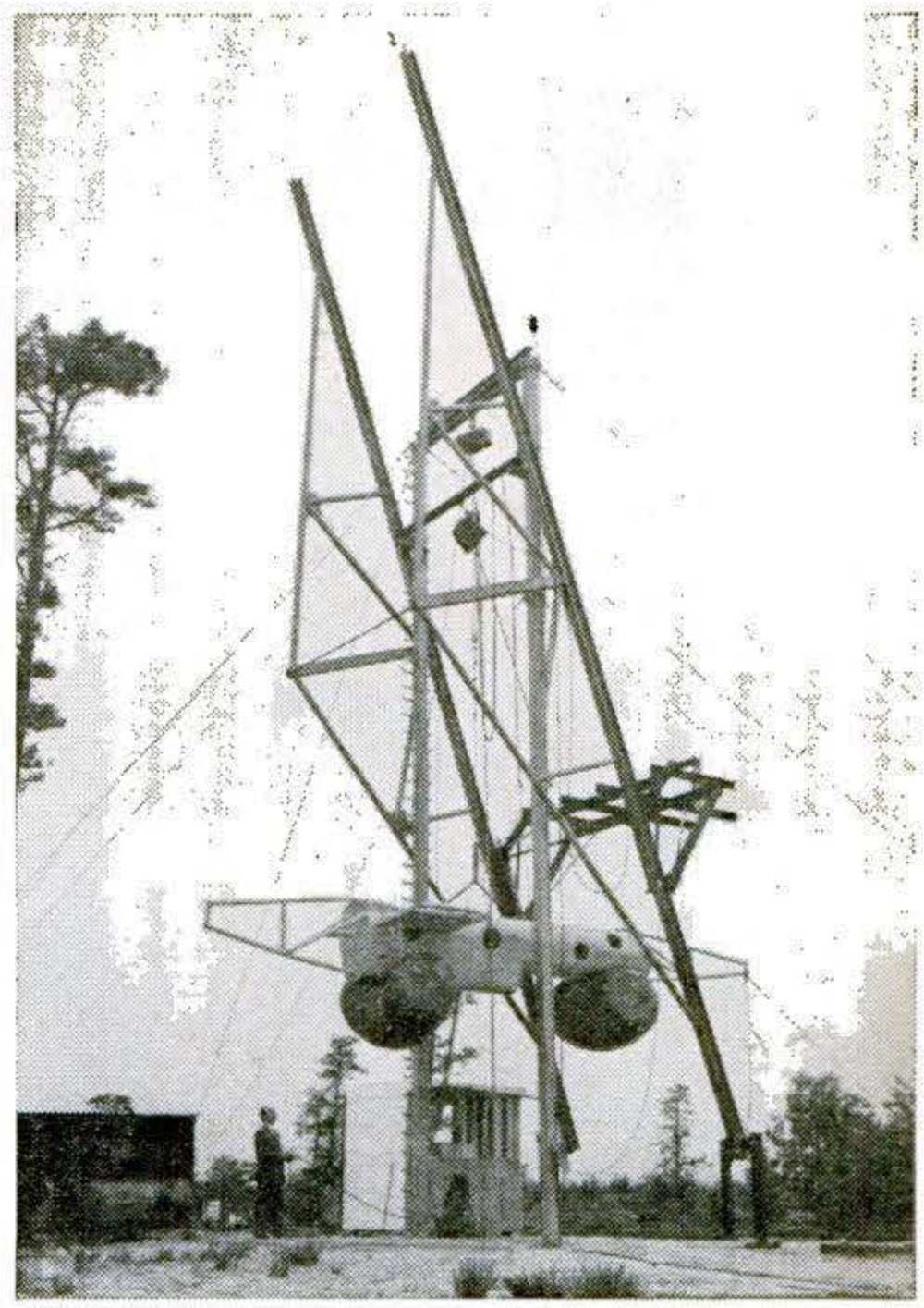


LATEST ADDITION is the funhouse, shown here getting finishing touches from Gross. He is constantly working on new attractions.

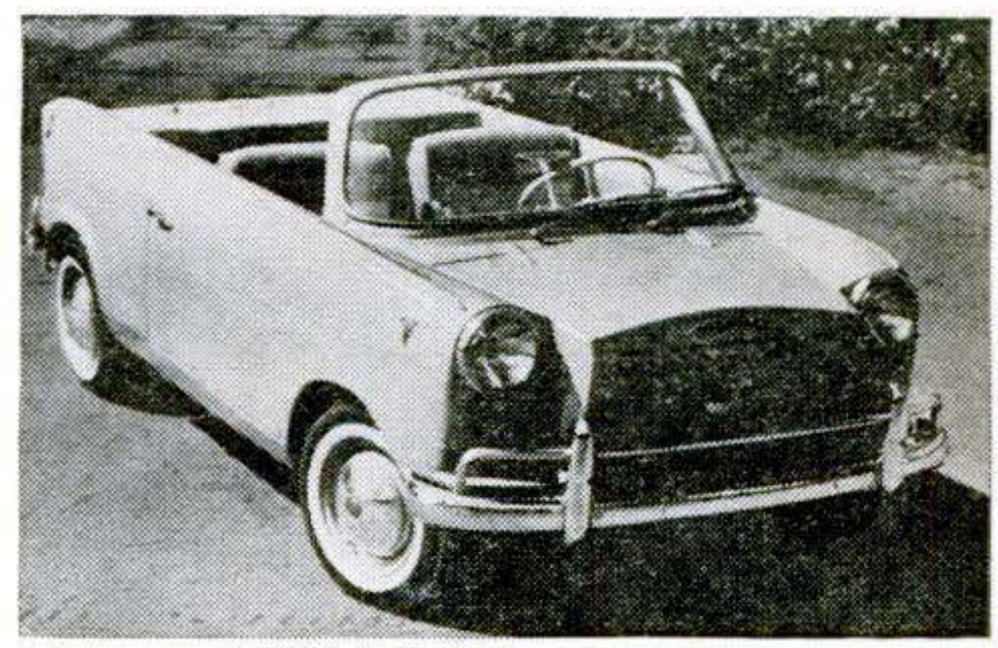


MOTOR HIDDEN IN BASE turns Ferris wheel. The attraction is realistically detailed, even to curlicues and numerals on the seats.



Bags save drones

When these braking bags hit the ground, air suddenly compressed in them breaks the diaphragms in their ends, letting the missile drone they're protecting land gently. Here they're tested on a drop tower at the Air Cruisers plant, Belmar, N. J. In actual use, they inflate automatically during descent of a drone, preserving it for further use. Various-size holes under the replaceable fragile diaphragms control deflation on impact.



Arabs' first car

A two-cylinder, four-cycle, air-cooled engine powers the little Ramses, first automobile produced in the United Arab Republic. The squat, angular body design kept tooling costs down. The manufacturer, Egyptian Automotive Co., claims 55 miles per gallon.

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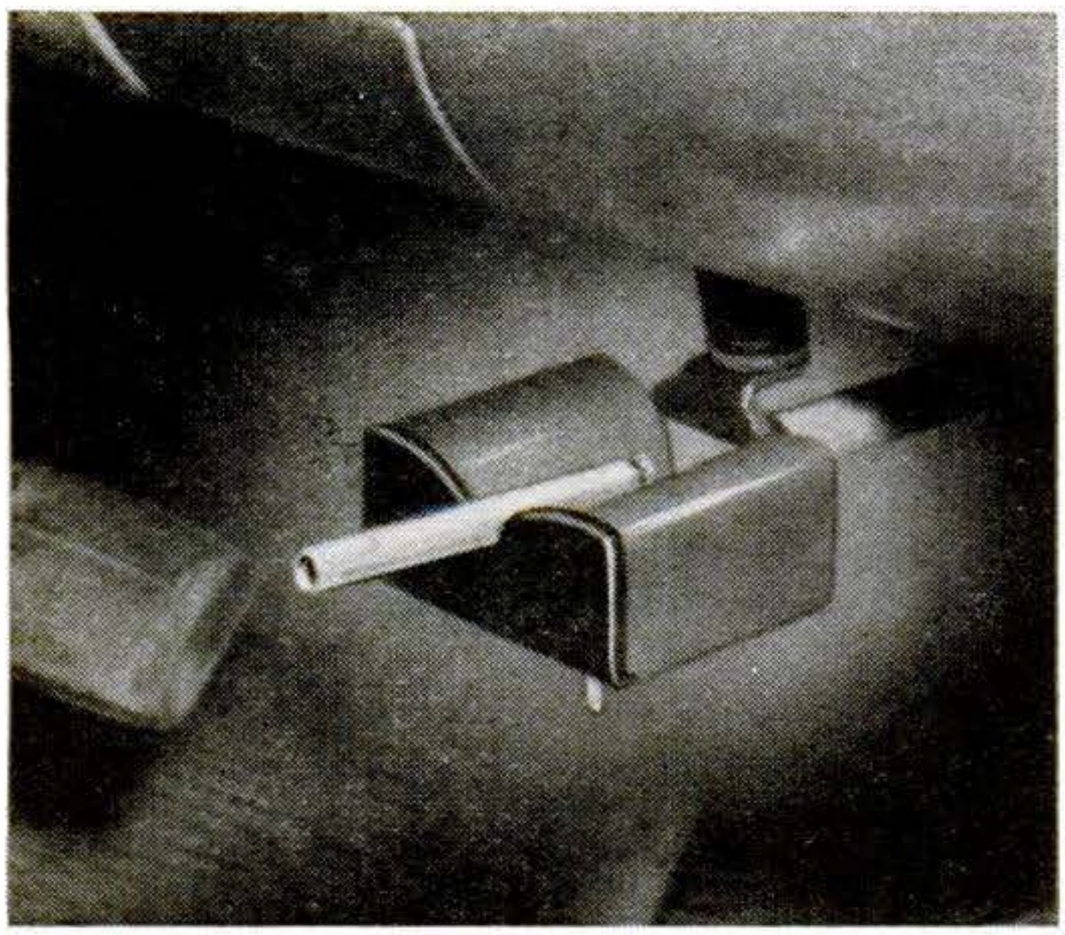
Compact Flood for Movies

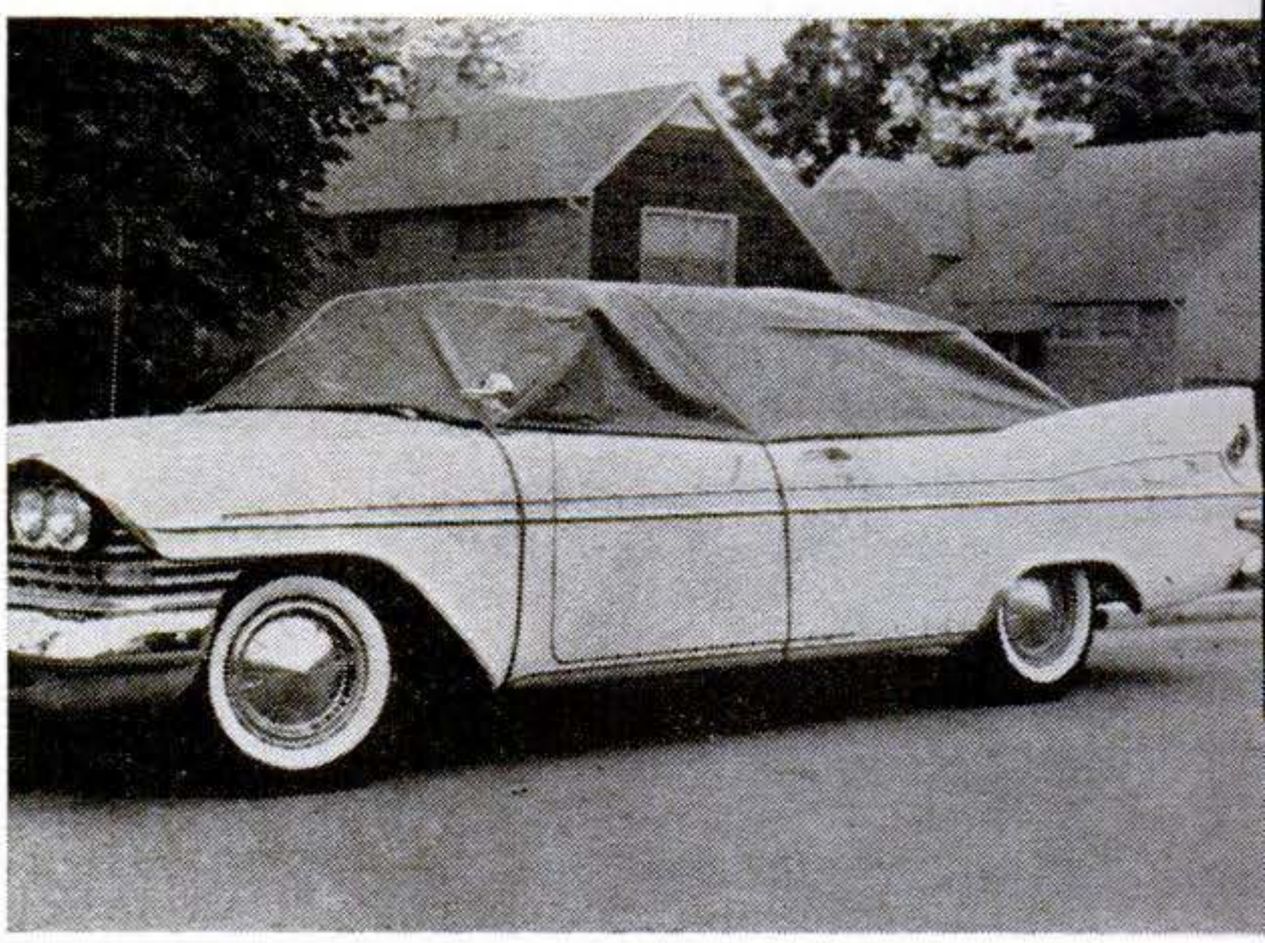
All the effective light of four R-30 photofloods on an 18-inch bar is put out by a single 650-watt halogen-vapor lamp in this 2¾-inch reflector.

The new Sun Gun flood lamp, for 8-mm. home-movie making, operates on 110-volt house current. It can be used without filters for Type A color film, as well as black and white.

Complete with lamp and 12-foot extension cord, it sells for $24.95; replacement lamp, $7.98. Sylvania Electric Products, Inc., 730 Third Ave., NYC.



VACUUM ASH TRAY is put into action by a lever beneath it to suck cigarette butts into an airtight container, smother them, and keep the smell of burning butts out of your car. You attach it below the dashboard, either extending outward or recessed under it. Jet-Out fits any car, can be installed with ordinary tools. $5.95. Orco Products, Inc., 7688 N. Interstate, Portland, Ore.



FIBER-GLASS COVER protects your car's top and glass from ice, snow, birds, and insects when you park in the open. It is fastened with strong elastic bands and rustproof hooks, can be removed in seconds, folded, and stored in the trunk. Three sizes: compacts and foreign cars, $7.99; other domestics, $9.99; station wagons, $12.99. Triangle Mfg. Co., 519 W. Pratt St., Baltimore, Md.

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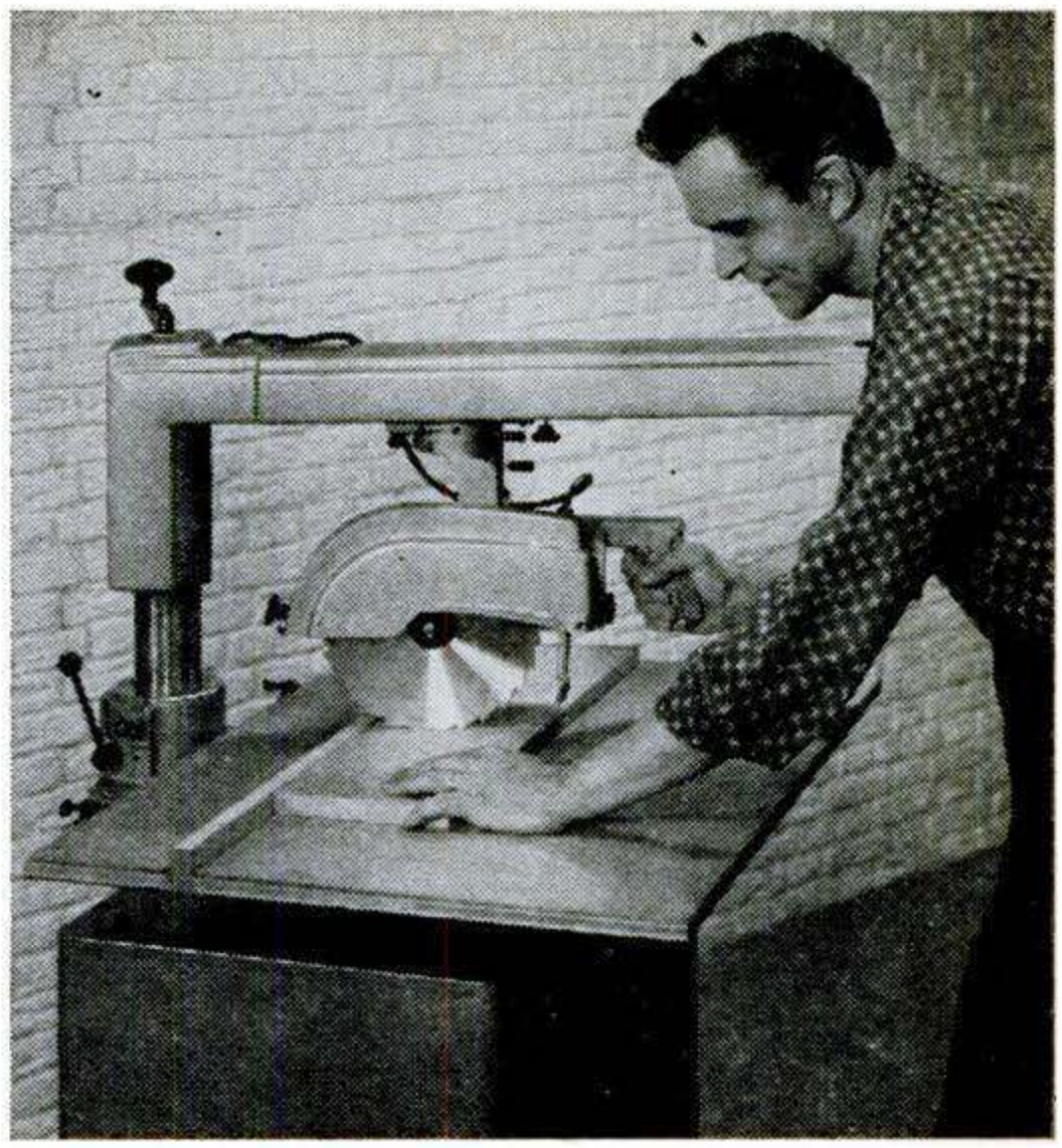
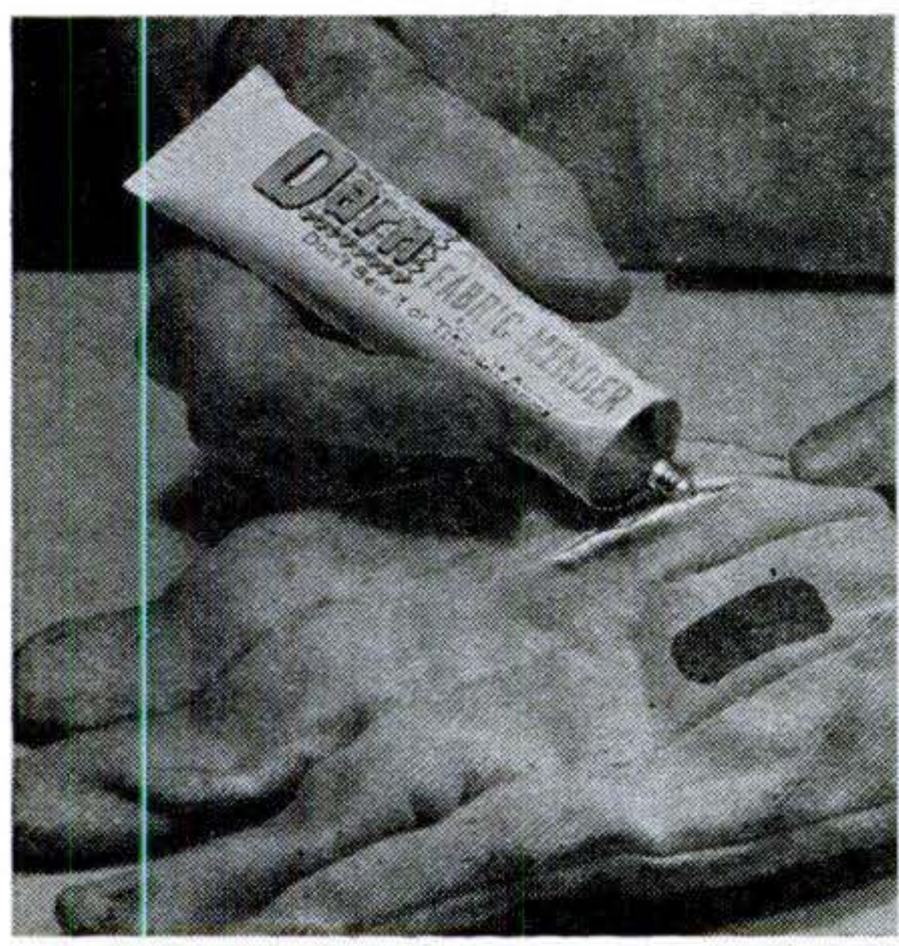
CEILING HEATER hangs overhead out of the way of children and pets when you need supplementary or occasional heat. It mounts on the surface, is 2¾ inches deep, and has no moving parts. One unit will heat a room up to 10 by 17½ feet in area. Cost, $54.95. Sun-Tron Corp., 7435 W. Wilson Ave., Chicago.

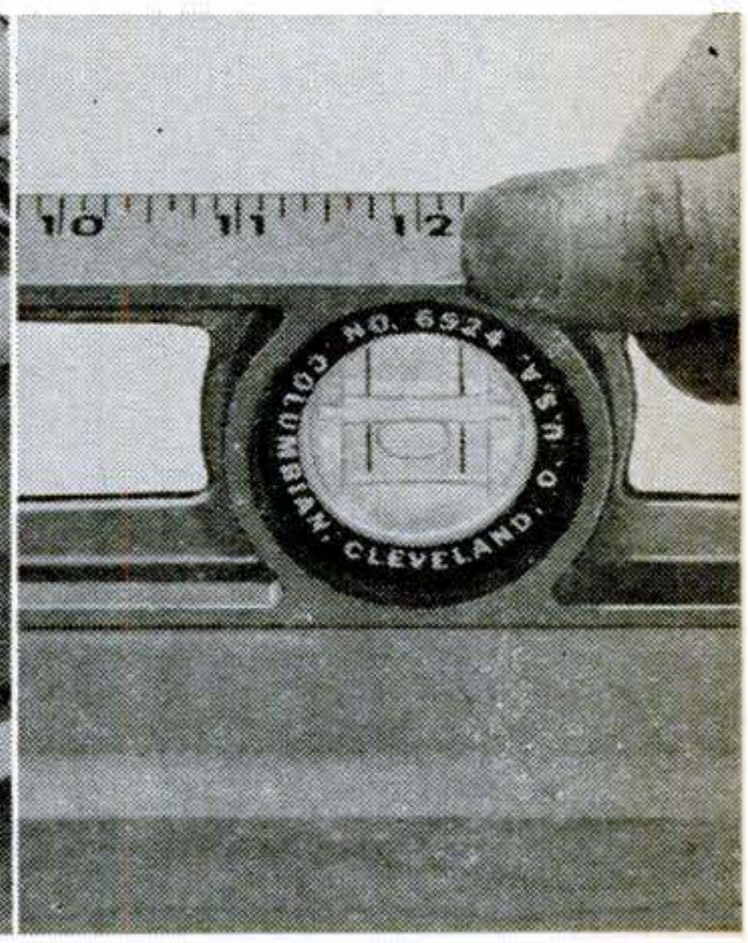


PISTOL-GRIP HANDLE gives you easy control over this newly designed radial-arm saw just added to the Craftsman line. It has adjustable tension, a trigger switch for intermittent operation, and a built-in blower to keep the table clean. Cost, $189. Sears, Roebuck & Co., 925 S. Homan Ave., Chicago.



FABRIC MENDER is applied like cement from a collapsible tube. You can use Darn to hold patches, seal rips, hem, or attach pockets or decorations to cotton, wool, and most fabrics. Per tube, 69 cents. Woodhill Chemical Corp., 1390 E. 34th St., Cleveland.

ELECTRIC PEELER fits into your kitchen disposer; takes power from it; thin-peels potatoes, onions, fruit, and other vegetables; gets rid of the skins; and cleans itself in seconds. PeelQuik sells for $29.95. Manesco, Inc., 605 Plandome Rd., Manhasset, N. Y.



ALUMINUM LEVEL has a two-foot rule on top marked in inches that can be read from either edge. It's called the Challenge and is manufactured in two models: with four vials, $4.50; six vials, $4.98. Columbian Vise & Mfg. Co., 9021 Bessemer Ave., Cleveland.

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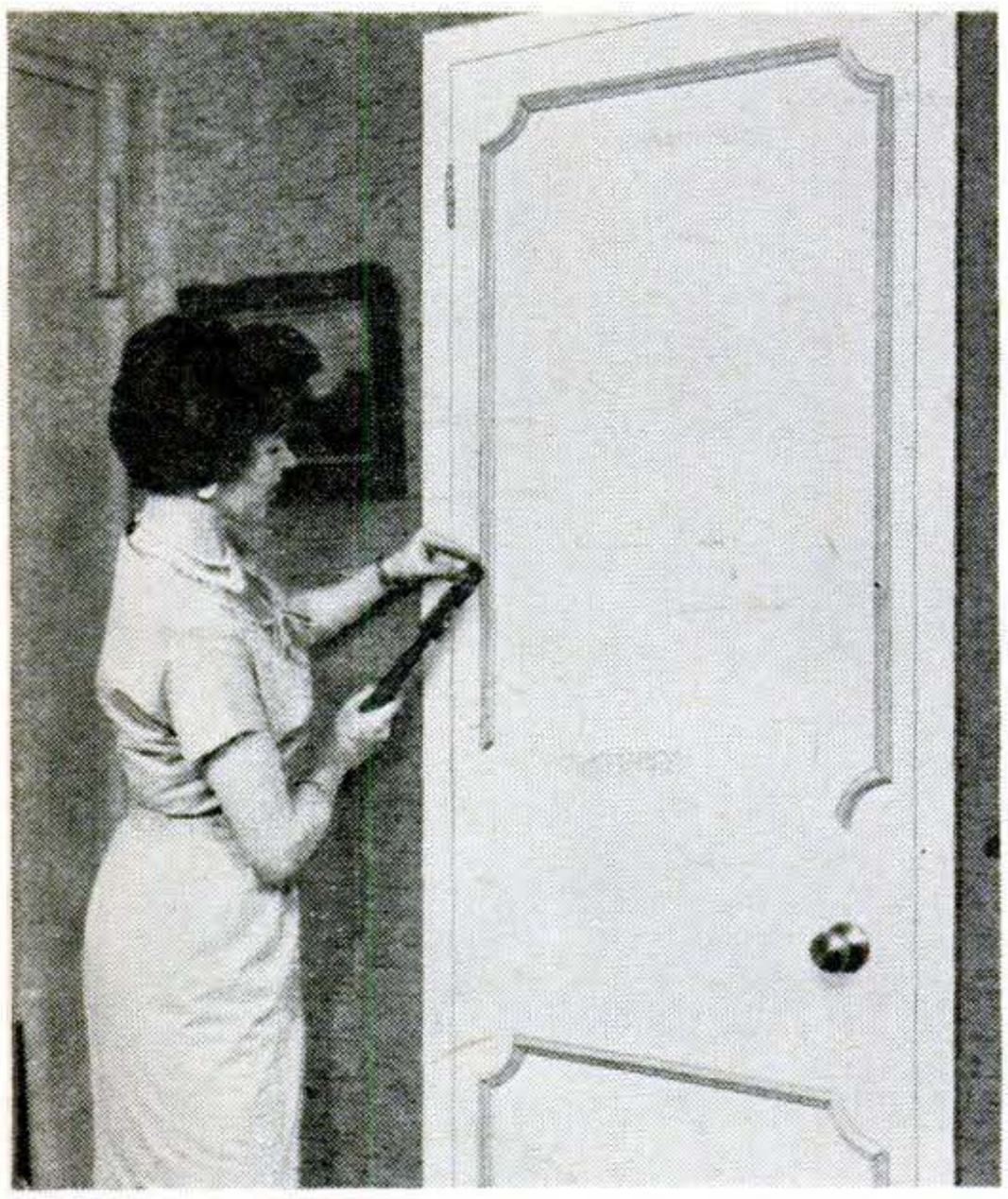
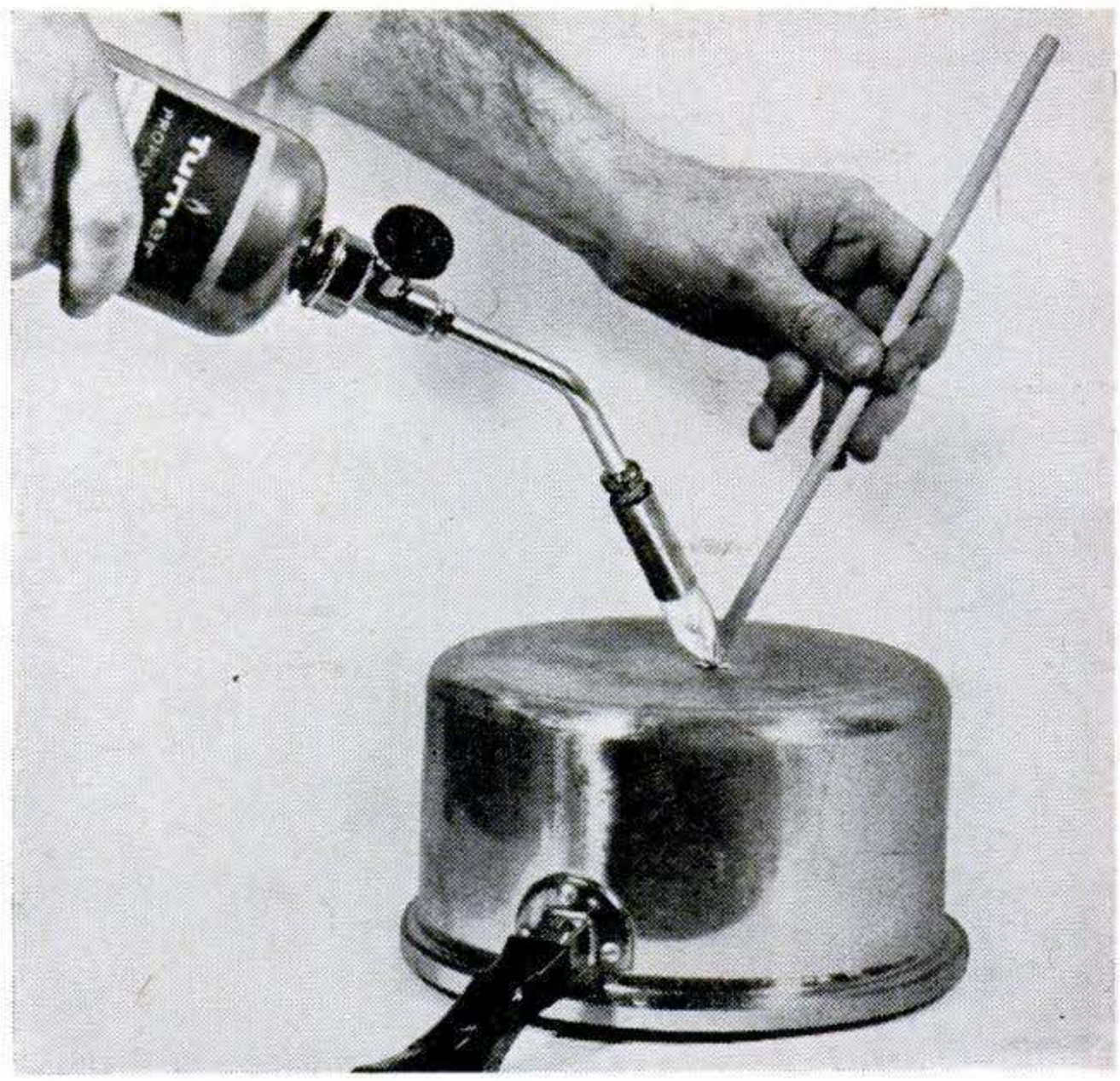
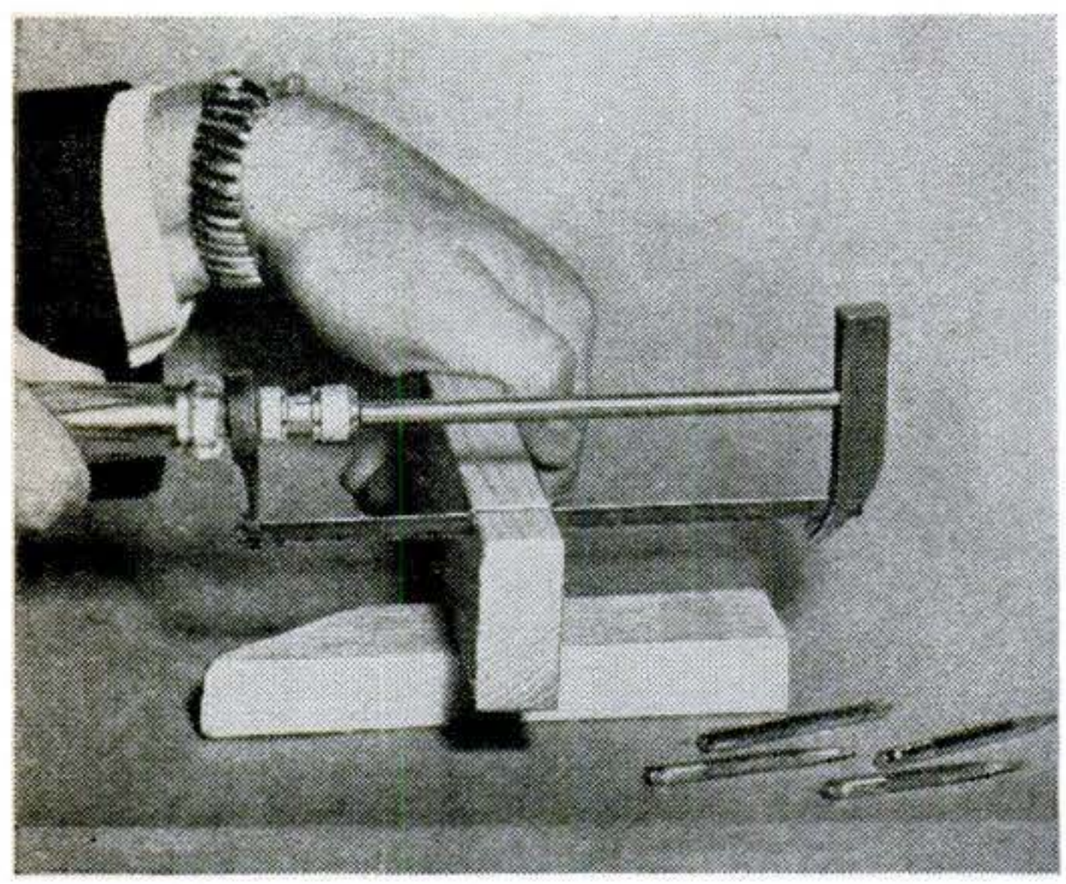
WHAT'S NEW



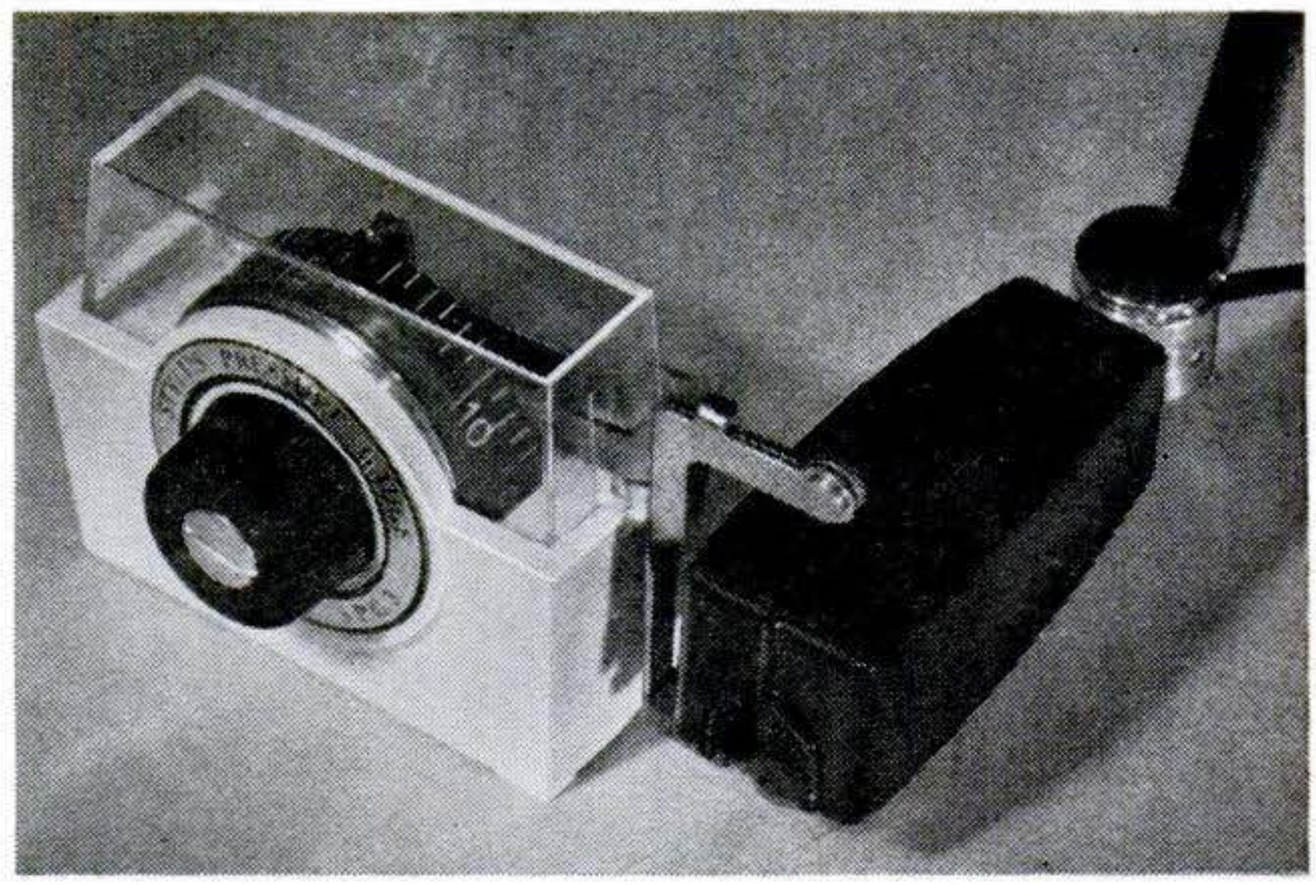
PACKAGED MOLDING contains all the molding and nails you need to restyle a flush door. Pieces are precut to size, premitered, and drilled for nails. They can be put up with a hammer and the aid of a full-scale working diagram included in the box. $8.88. Bendix Mouldings, Inc., 192 Lexington Ave., NYC.



TORCH KIT includes the tools and materials you use for common soldering. Besides a propane torch and fuel, it contains a chisel-point soldering tip, bar of 50/50 lead solder, bar of aluminum solder, and can of flux. The kit sells for $8.95; replacement fuel, $1.95 a tank. Turner Corp., Sycamore, Ill.



SEVEN-IN-ONE TOOL combines a hammer, wood or metal saw, one Phillips and two straight screwdrivers, awl, and nail pull in one tool. You simply turn a screw in the handle to interchange them. The handy little tool is made in West Germany. $2.95. World Marketing, 23722 111th Pl. W., Edmonds, Wash.



STYLUS-PRESSURE GAUGE measures force exerted on a record by the tone arm. Its scale is marked in ½-gram divisions. The SPG3 gauge is a swivel balance having a plastic pan on which the stylus rests at record-surface level. $2.95. Garrard Div., British Industries, 80 Shore Rd., Port Washington, N. Y.

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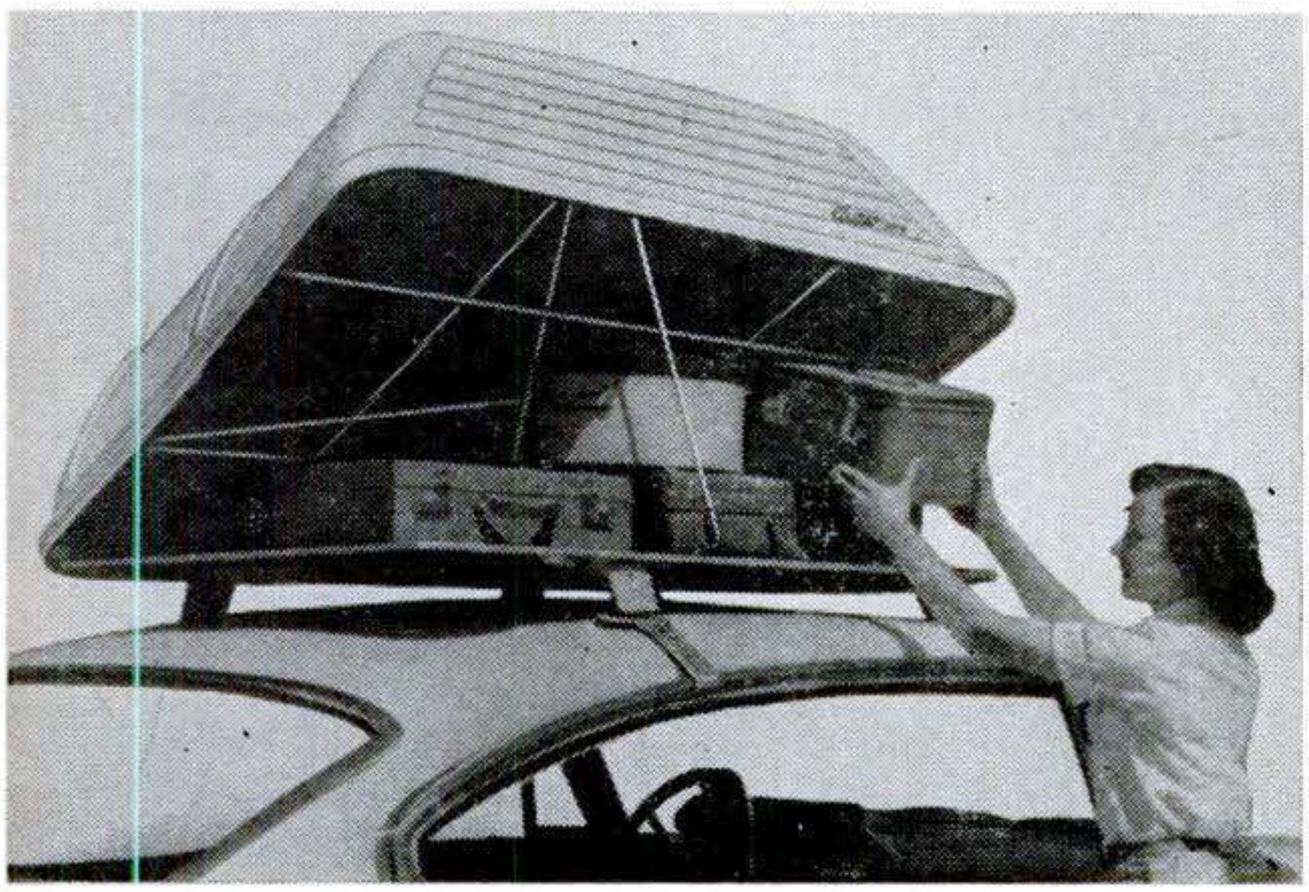
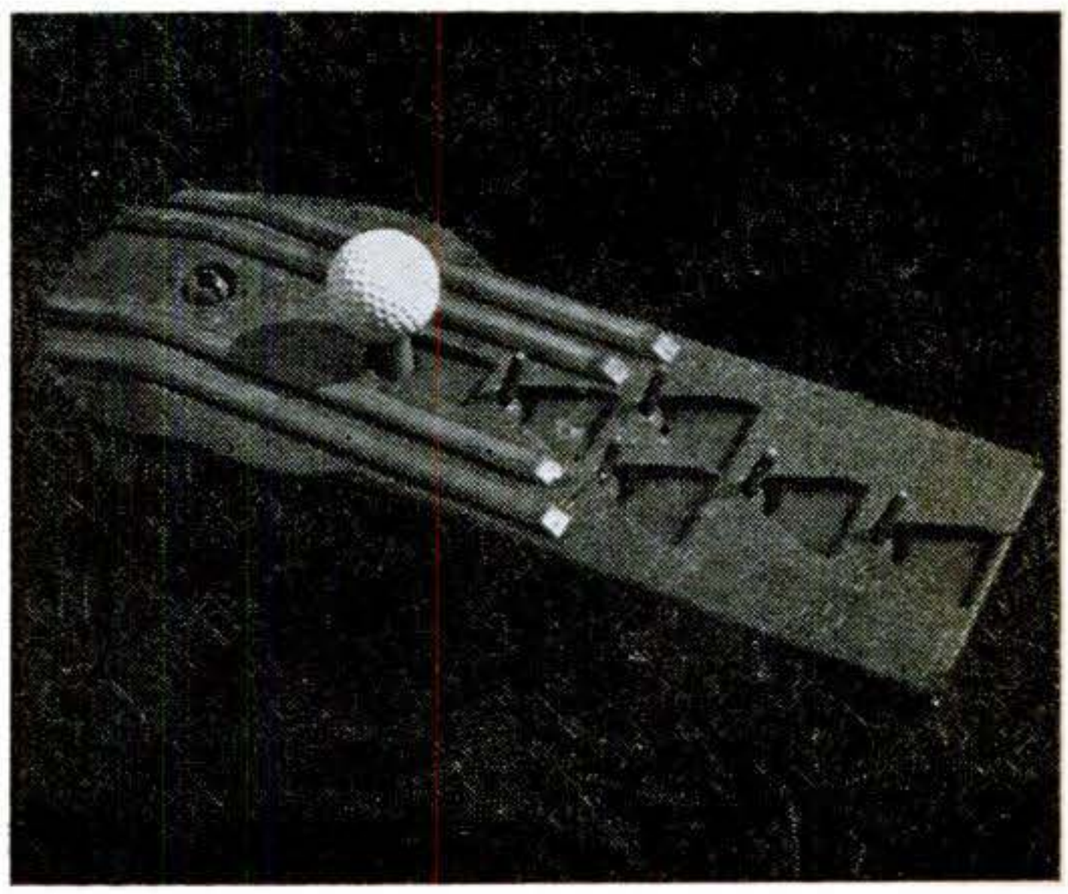
Hot-Water Mix Works by Solenoid

Pushbuttons control solenoid valves that mix hot and cold water in a unit mounted near the hot-water tank instead of at the faucet. The system cuts down on heat loss in pipes through a long run of hot water, gives right temperature instantly.

Pushbutton panels, relays actuated by 24-volt transformers, and solenoid connections are made for kitchen sinks, lavatories, tubs, and showers. Buttons are marked for hot, cold, warm, extra warm, full or gentle flow. $100 to $200, depending on model. Ultraflo Div., American Sanitary Mfg. Co., Abingdon, Ill.



CAR-TOP CARRIER has fiber-glass cover on a plywood platform to keep luggage dry. It is 14 inches deep, 48 wide, and 58 long to provide plenty of storage space on top of conventional cars and station wagons. It's equipped with a tamperproof lock, costs $59.95. Fabricon Products, River Rouge, Mich.



GOLF-SWING INDICATOR is a practice tee that judges your follow-through indoors or out. Pins in front of its flexible tee fold to one side or the other for a hook or slice, fall straight if the swing is perfect. It's made of Marlex polyethylene, sells for $6.95. T. & C. Enterprises, Inc., Warren, Ohio.

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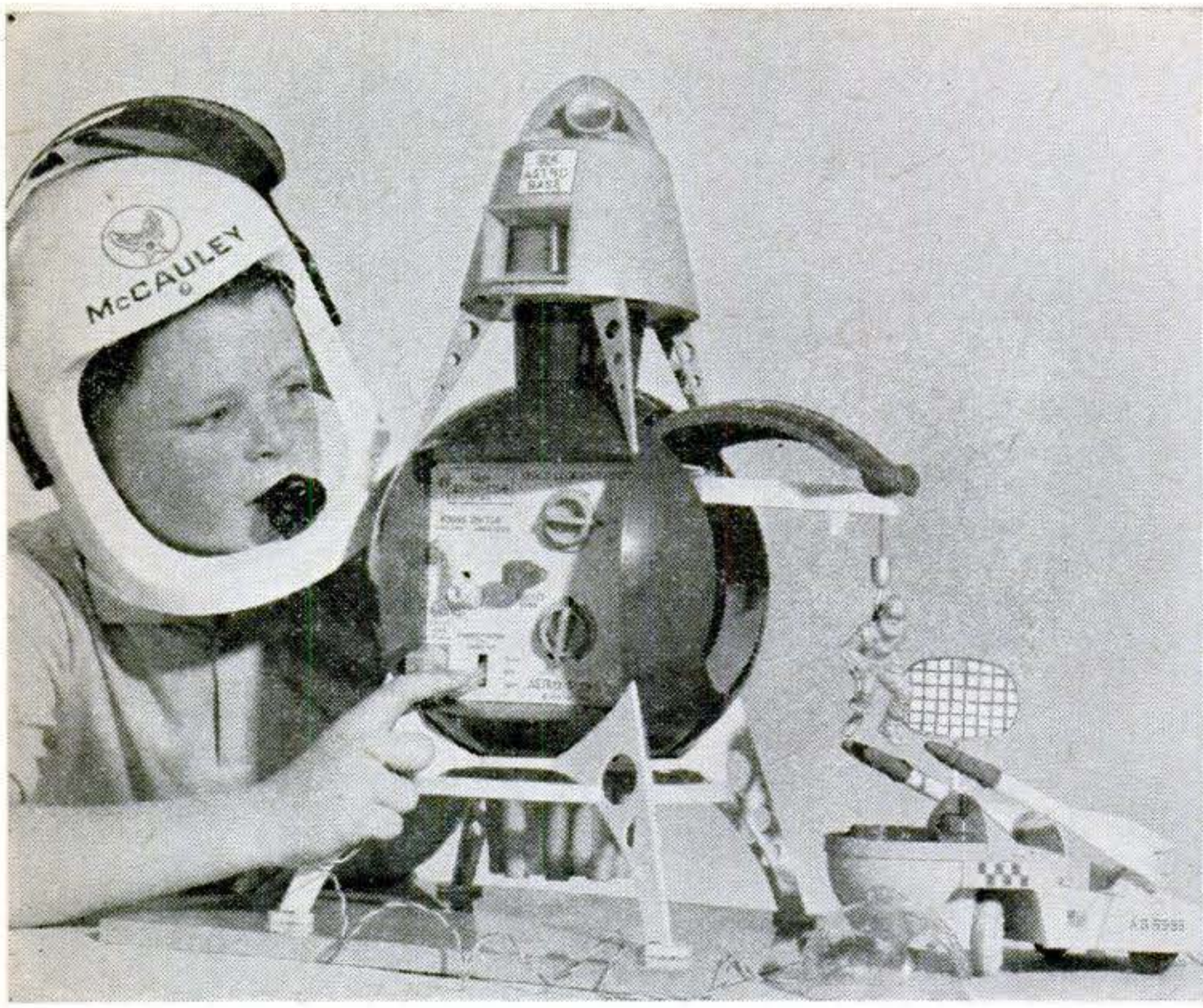
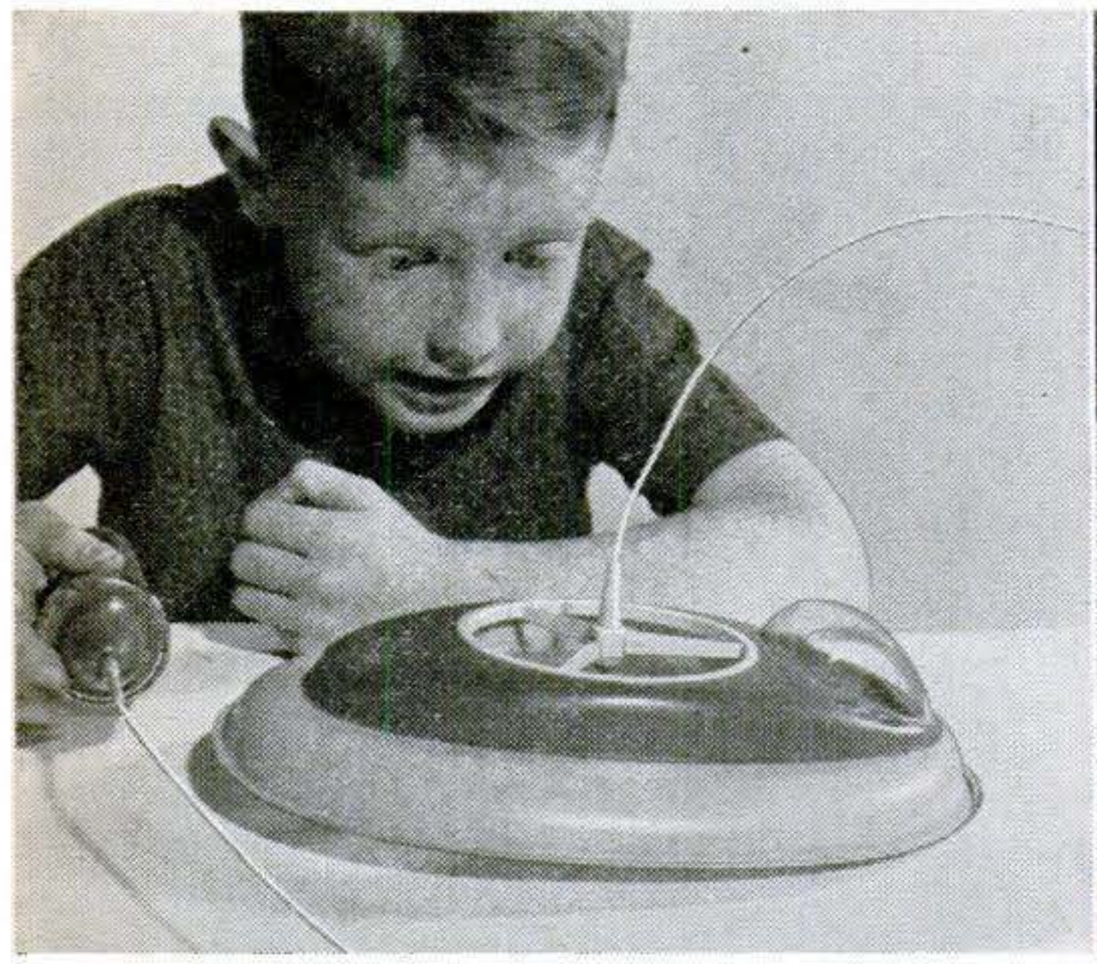
WHAT'S NEW IN TOYS.....



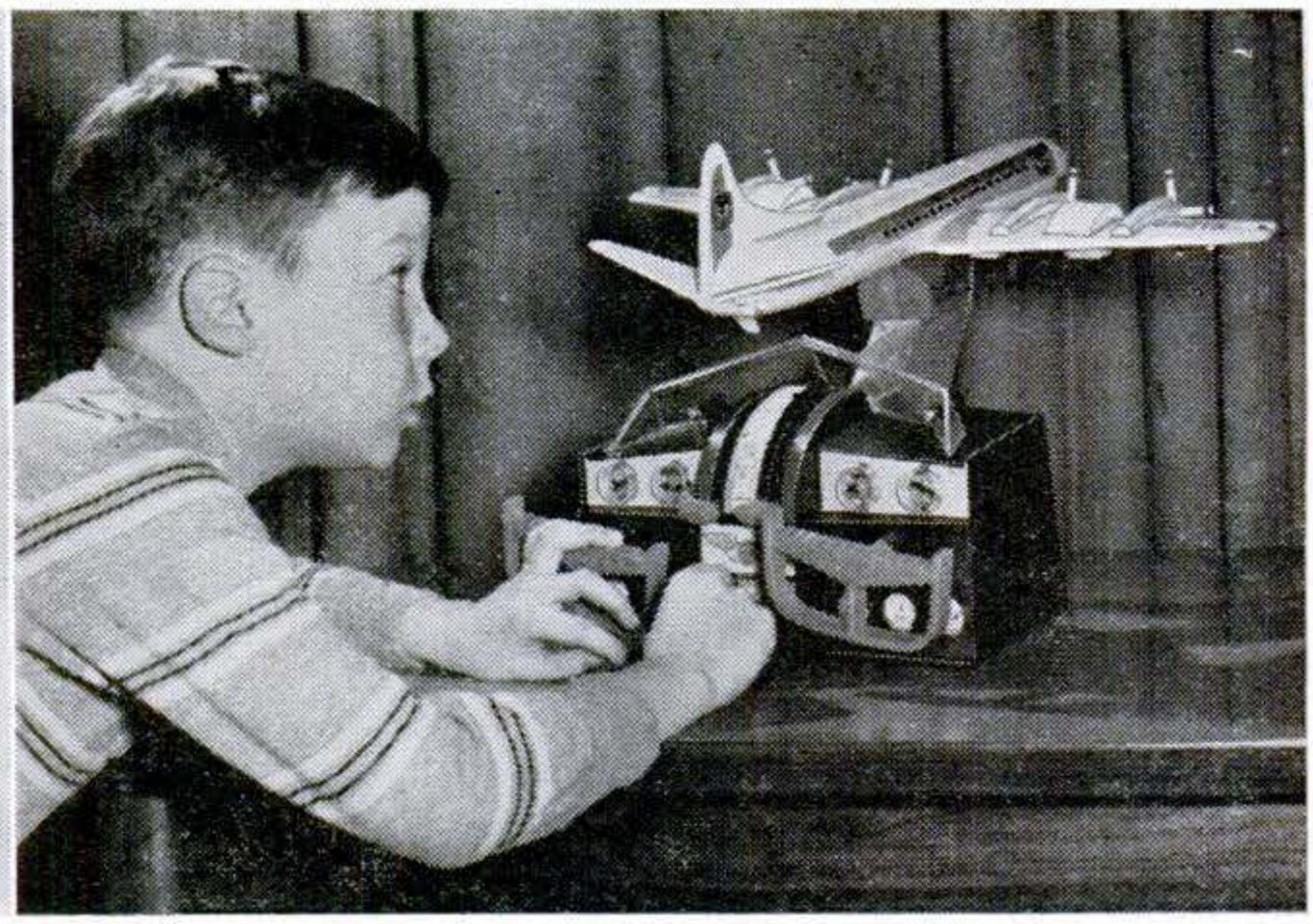
A Space Port for Junior

Instrument panel and viewing screen allow young rocketeers to operate this Astro Base. Machine-gun noises, flashing lights, space lock, loading winch, and maneuverable scout car are remote-controlled. The toy has two flashlight-battery-operated carbon-brush motors. Price: $20. Ideal Toy Corp., 200 Fifth Ave., NYC.

POWER SAW enables children to make toys from styrofoam sheets, but can't cut their hands. Sheets are included. Two flashlight batteries run the tool. $5. Gong Bell Mfg. Co., East Hampton, Conn.



MINIATURE AIR CAR rides on a cushion of air. Like the full-size experimental models being developed by major manufacturers, the wheel-less, wingless craft skims over land and water without visible support. It's battery-operated, and made of red and yellow plastic. $2.98. Victor Stanzel Co., Schulenburg, Tex.



JET-PROP AIRLINER is operated by dual aircraft-type controls. It dives, banks, climbs on command, and has blinking landing lights, retractable landing gear, and variable-speed engines that emit a high-pitched jet whine. $14.98 less batteries. Remco Industries, Inc., 113 N. 13th St., Newark, N. J.

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SERVICE STATION and garage has miniature parking facilities and gas pumps, as well as lubrication, battery-charging, and tire-inspection equipment. A motor powers the car lift. Also included are toy cars, trucks, and attendants. The all-metal, three-story station sells for $8.95 complete. T. Cohn, Brooklyn, N. Y.

PLANE MODEL of Lockheed P-38 is the first twin-engined, ready-to-fly toy airplane. It's an accurate copy of World War II's famous fighter. Twin booms mount starter-equipped .049 gas engines. $19.98, complete with battery, control handle, guide lines, and fuel. Wen-Mac Corp., 1151 Tennessee Ave., Los Angeles.

A-POWER PLANT is an 18-inch-square scale-model kit designed from Westinghouse blueprints. Included is a booklet on the nature, history, and uses of atomic power. $6.95. Revell, Inc., Venice, Calif.

FAST-DRAW GUN, strapped to the wrist with a leather band, snaps lightning-fast into the hand with a flick of the wrist. It has a chromed barrel, white grip. Cost: $2.98. The Hubley Mfg. Co., Lancaster, Pa.

PLASTIC ROBOT has transparent body that reveals its multicolored gears. The 18-inch device walks, swings its arms, moves its jaw, squawks, and rings a bell. $12. Ideal Toy Corp., 200 Fifth Ave., NYC.

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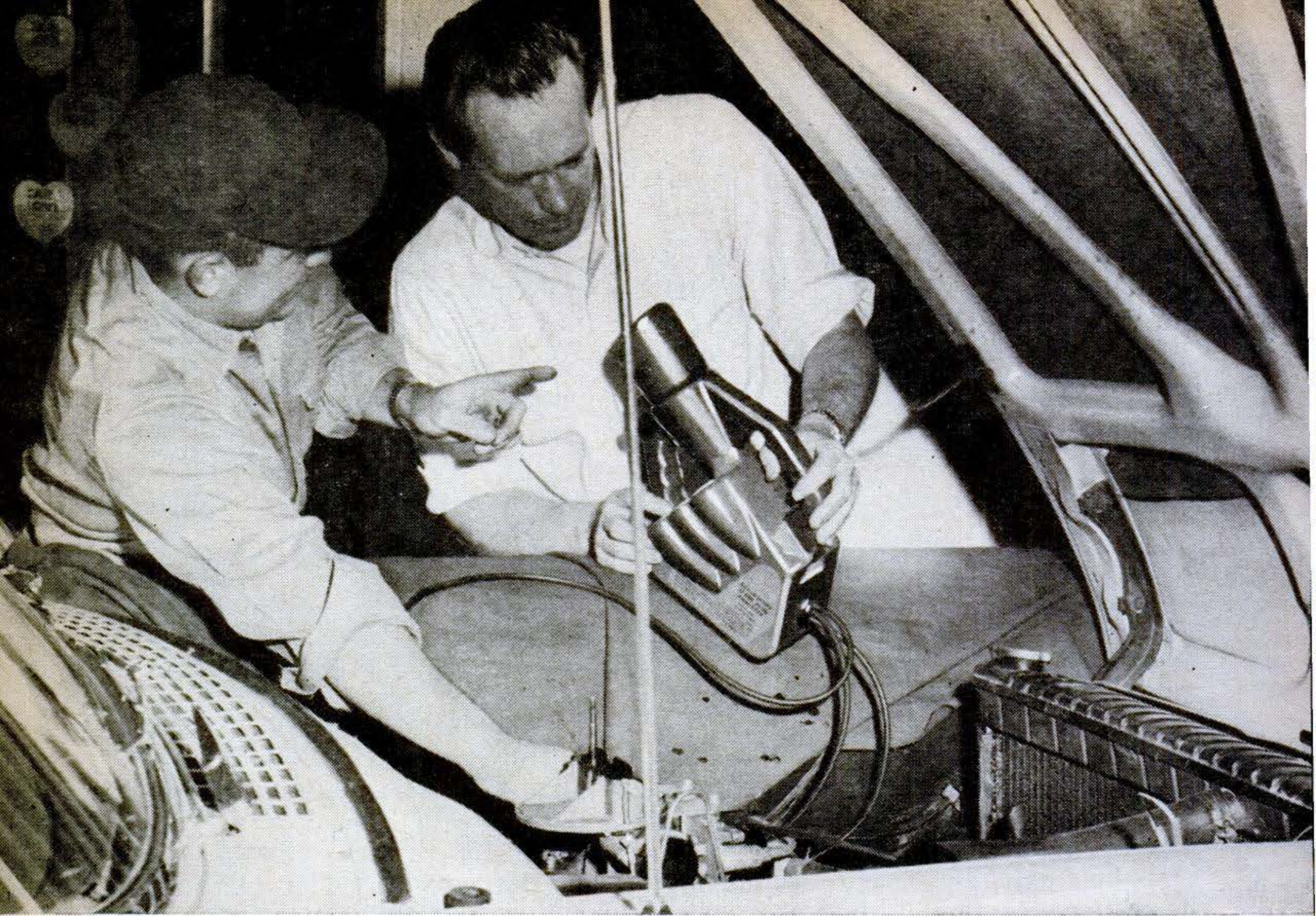

AC scope has no horizon line by which to judge height of firing trace. But you can spot abnormal patterns by comparing with drawings printed on the side of the instrument.

How Good Are Those New Spark-Plug Scopes?

Are they just gimmicks to sell you new plugs? Or do they really fill a need? We tested a batch to find the answers

By E. F. Lindsley

ONE of these days—if it hasn't happened already—your filling-station man may attach a strange-looking gadget to your car's engine and peer knowingly at this newest device for making spark plugs confess. He may accompany this with some doctor-style tongue clucking or, if he works hard at it, offer up what appears to be a prayer of last rites for your engine. Most servicemen, fortunately, will play it straight.

Actually, he's looking into a small cathode-ray oscilloscope. The idea is to check spark-plug performance with the plugs still in the engine and operating. Older cars, and some modern ones, may not fret much if spark plugs leave a bit to be desired. But really sophisticated modern engines demand the best from plugs. Pulling and inspecting them when overlaid with power-steering pumps, air conditioners, power-brake connections, and such bric-a-brac can run into real money. Here a plug scope that takes only seconds to clip on can be as convenient as a doctor's X-ray. If it tells the story

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without opening up the patient, everyone's happier.

How good the diagnosis? Just what does the plug scope tell, and how well does it tell it? This is the big question and the motorist is entitled to an answer. In the mind of a man who has shucked out a sawbuck for new plugs there is sometimes a lingering suspicion: Has he just been bilked by a mysterious green light about as meaningful as a fruit jar full of glow worms?

The spark-plug manufacturers who sell the scopes to their dealers acknowledge that this could happen. But they quite rightly point out that each scope, in its own way, can be an accurate, legitimate, time-saving tool that tells a story never before available at most service stations.

Engineers have been diagnosing engine conditions for years with lab scopes. In engine labs you'll see the curvaceous green traces dancing around to the tune of everything from cylinder pressures to crankshaft vibrations. Airlines have built-in ignition scopes. (I can attest to the comfort a scope can give when, high over the north Atlantic, it says that the roughness in one engine is just a fouled plug and not a mag about to tear up.) But the very precision of the scopes has until recently kept them out of the gas stations. Who wants to put almost a thousand dollars into equipment that could be jammed up by the youngster who hops pumps?

Each of the major plug makers, AC, Autolite, and Champion prodded their engineers to come up with a scope that would be rugged, reliable, easy to use—and very inexpensive. The fact that each company produced an instrument that presents a different picture on the screen can be attributed to certain differences in engineering viewpoints.

The scopes do differ. And each builder vigorously defends his own version. To really see and appreciate the variations, you can ask a dealer for each brand of plug to run a check on your car.

I tried them all—first under the guidance of factory engineers, and later in the quiet of my own garage. To provide a standard, I built a Heathkit ignition analyzer, a more sophisticated instrument, and ran it beside gas station jobs.

Dancing pickets. The Champion scope was first on the market. Resembling a

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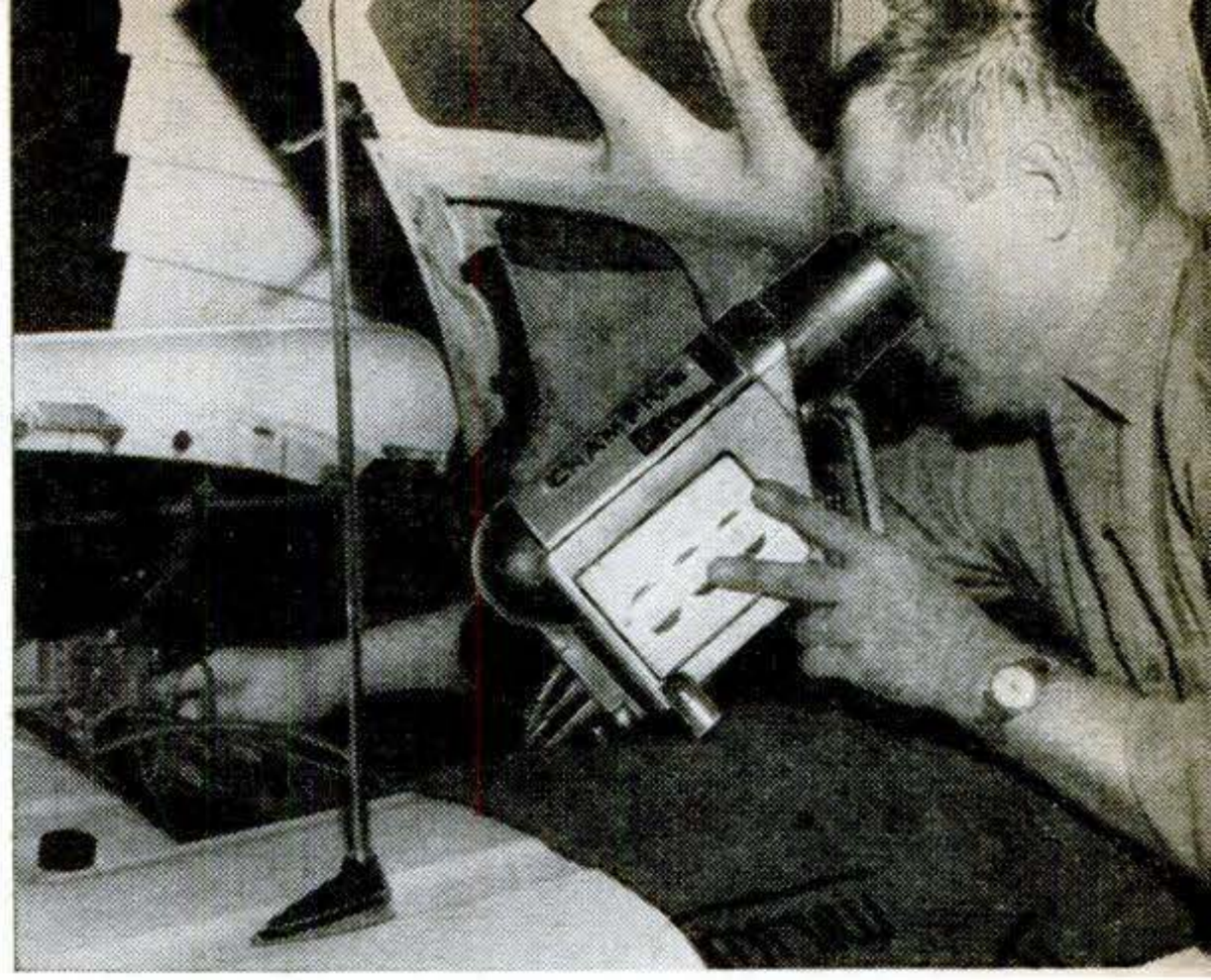
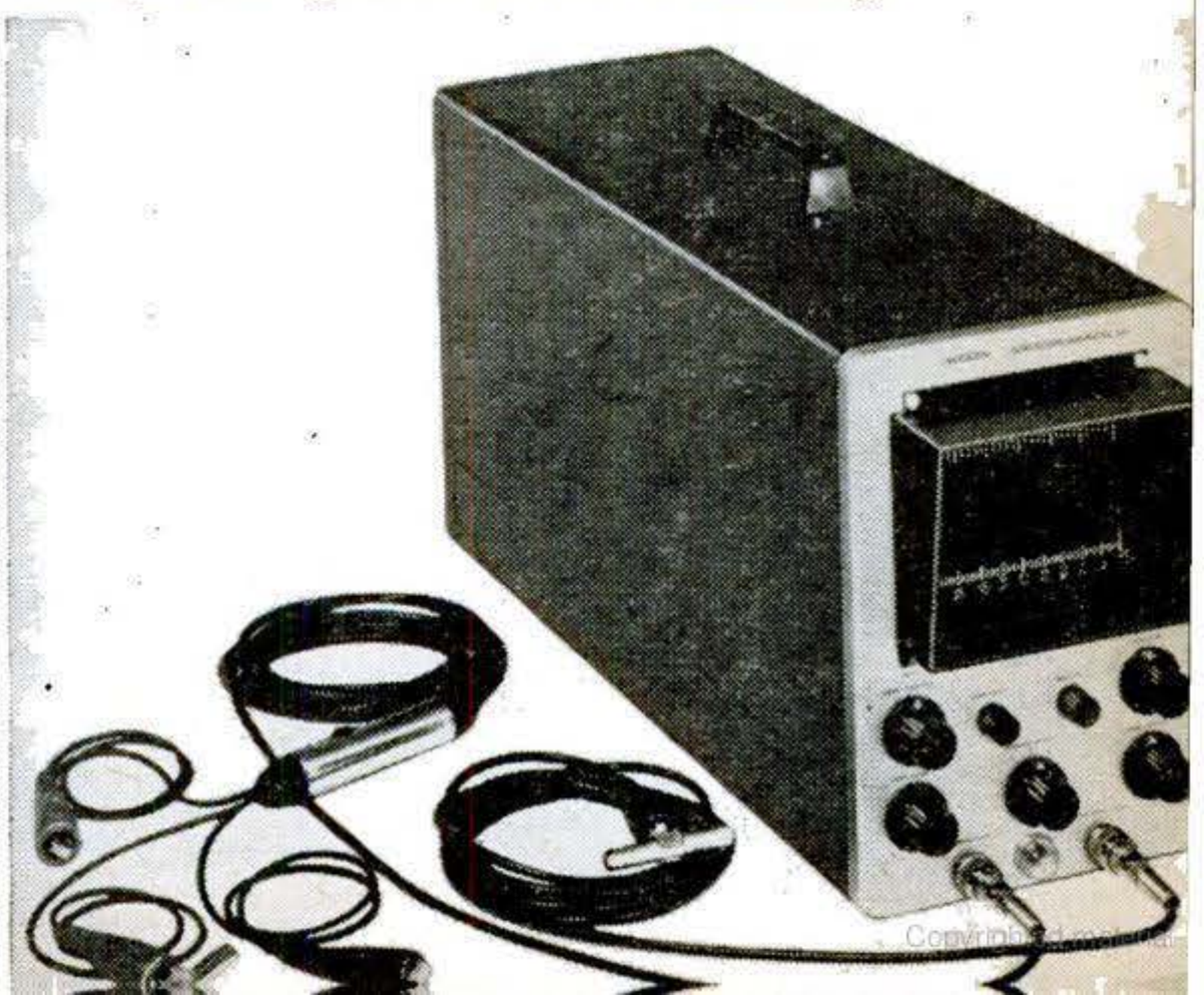


CHAMPION has simplest trace. Pattern resembles fence pickets. When you gun the engine, a picket zooming above a horizon line indicates a bad plug.

AUTOLITE has a larger screen and the trace tells more. It isn't as easy to interpret, but an experienced man can detect a wider variety of ignition faults.

HEATHKIT does everything the others do—and more. It requires more time and study to use, but its ability to spot unsuspected ignition faults is amazing.



menacing large-bore handgun, the Champion scope puts out a picture much like a series of closely spaced fence pickets. These pickets will probably be a bit uneven in height; this is normal. Gun the engine briefly and they'll pull closer together and shoot up a bit higher. If your plugs are in good shape the pickets will stay below the horizon line drawn across the glass even when you gun the engine. Bum plugs zoom the pickets above the line. It's as simple as picking out a man on stilts in a roomful of midgets.

Technically, the height of the trace indicates the voltage required to fire the plug. A high trace shows that the plug is pulling more voltage than it should, leaving less in reserve.

The scope can also check general ignition-system condition by showing the voltage reserve. Disconnect one plug wire completely and the coil energy has no place to go. The trace should rise to the top of the scope. If it doesn't, points, coil, and condenser need checking. On the other hand, a short in a plug wire, distributor cap, or conductive fouling across the plug gap shows up as a low trace.

Again, disconnecting that particular plug should shoot the trace into orbit if it's just a fouled plug; but if the short is between the coil and the plug, the trace will stay low.

With the exception of reversed coil polarity (which all scopes show), that's about as far as Champion expects you to go with their scope. It's not intended to be an analyzer of complex ignition ailments. To satisfy myself on this, I installed a few man-made troubles that showed clearly on the Heath analyzer but left the Champion scope undecided. In short, don't blame your garageman if he sells you a set of plugs in good faith and they don't cure the worn-out distributor bushing.

GIMMICKED PLUGS and ignition-system trickery were installed in writer's Jeep to simulate actual troubles. Faults that sneaked by plug scopes were readily spotted with the Heathkit.

Can the Champion scope be jimmied to make healthy plugs look sick? Yes, they all can. So can an electrocardiograph unit in a hospital. Also, although it doesn't take much training to use the scope, and although Champion went all out to produce a service tool suited to a realistic level of user ability, careless use can make the test misleading. This applies to all scopes and so does the observation that they are not all equally stable and easy to use. I tried several of each make. Some danced around too much to reach any conclusion.

For you, the motorist, this is not a difficult problem. Simply look at a scope and judge for yourself if the traces are steady enough to be trusted or if the unit is out of whack. Don't expect television standards. Because of constantly changing combustion-chamber conditions, no scope holds dead steady. But do expect the traces to line up and be counted 4, 6, or 8, according to cylinders, and expect them to hold still, sideways, pretty well.

The moving "flame." The AC Spark Plug Division of General Motors came up with another gun-style scope. This one, in red semiflexible plastic, looks like a jump rocket ready to strap on a spaceman's posterior. Where the Champion scope blurs the focus intentionally to emphasize the picket-shaped trace, the AC job shows a fine-line trace in a flame-shaped pattern.

Again, each cylinder parades in firing order. The gunning test pops the traces higher on the screen as the engine is momentarily loaded. Extra-high traces show high-voltage requirements jointly or singly, and low traces show narrow gaps, shorting, or conductive fouling. AC is proud of the ability of this scope to reveal lead fouling. This is a deceptive condition, tough to find by ordinary

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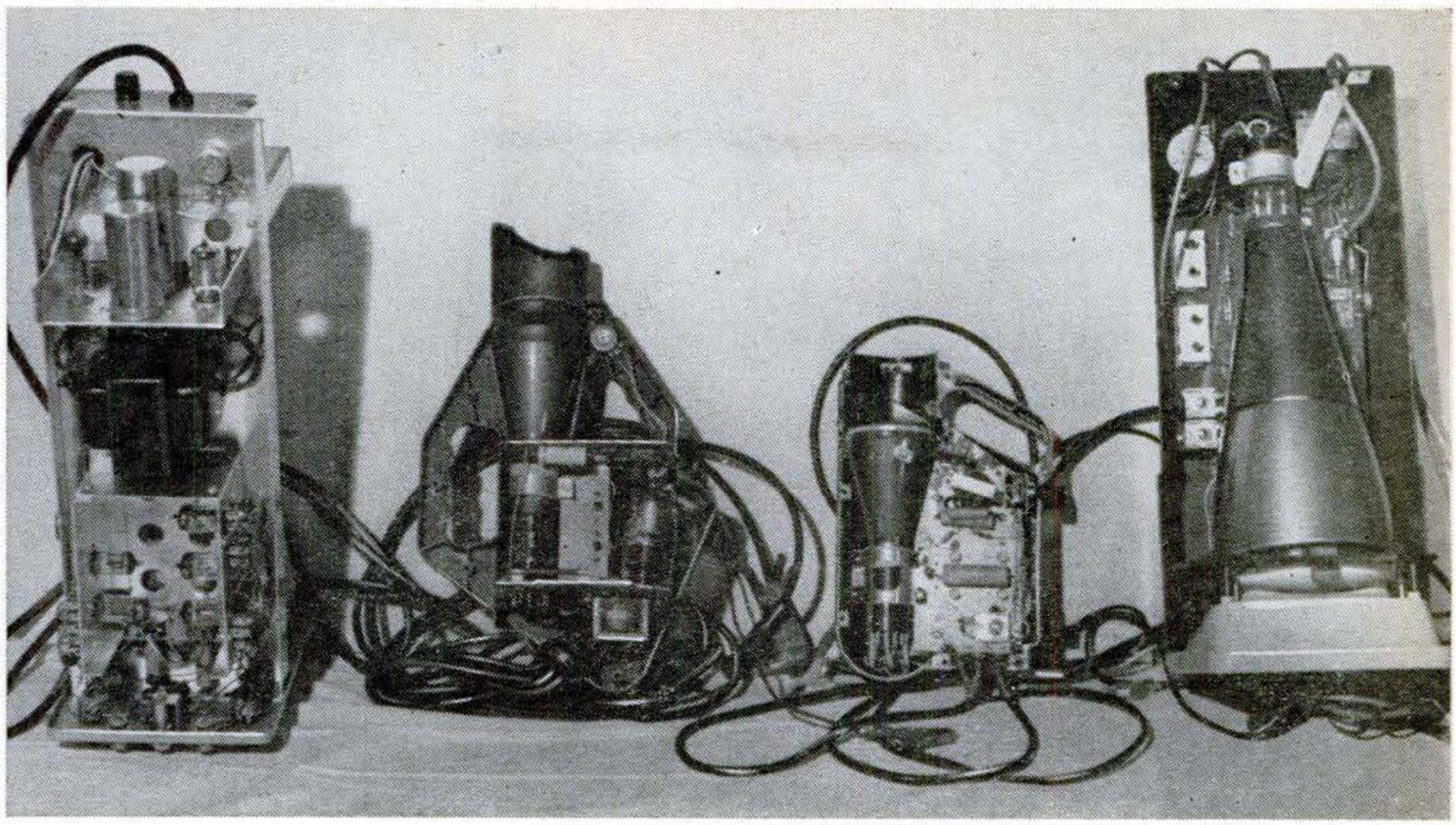
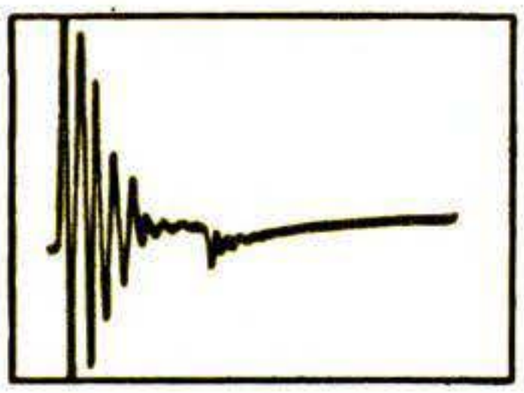
look sick? Yes, but so can an electrocardiograph unit

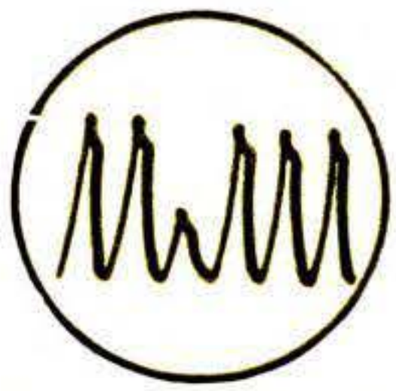


HEATHKIT



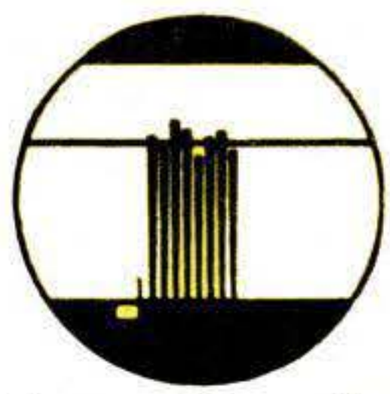
A single misfire looks like this. Analyzer can also display all cylinders in parade or superimposed — primary or secondary.

AC



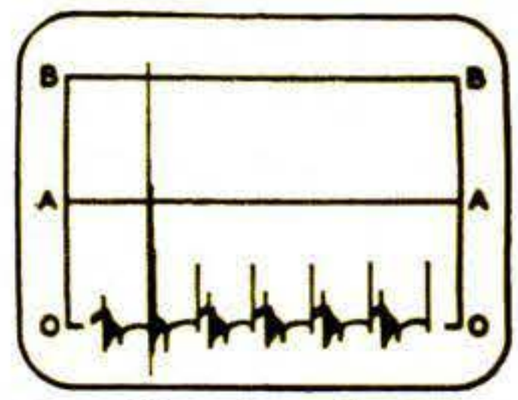
Firing of each plug shows up as a peak in the trace. Five of these are okay; the third plug in the firing order is fouled.

CHAMPION



Pickets rising above the line indicate plugs requiring excessive voltage. Fouled plugs show up as very short pickets.

AUTOLITE



Details of each firing pulse are shown in parade. High spike results from removing one plug wire for voltage-available test.

means since the lead deposits are conductive only when hot. If a trace pattern fades after 15 or 20 seconds of fast idle on a hot engine, lead fouling is indicated.

The AC scope does not have a horizon line by which the height of the firing trace can be judged. In a sense, such a line is like the red for "bad" and green for "good" on a drug-store tube tester. With a reasonable amount of practice, a serviceman will quickly spot abnormal traces. Also, AC points out that it has made special efforts to train their scope users before turning them loose on the public. It's possible, though, that the lack of a line does make it tougher to show the typical customer a bad and a good.

Again, it is likely that some garages will try to use the AC scope for ignition analysis at the postgraduate level. It cannot and will not do this in the hands of most gas pumpers. However, someone with a high dome full of electrical savvy can undoubtedly obtain excellent clues from its saw-tooth wiggles.

If you have doubts about the station man's interpretation of the scope, take a look for yourself. A good AC scope, properly operated, will hold a fairly steady pattern. The traces will look pretty much like one of the six little drawings put on the side of the scope for comparison. Pay special heed to how high the traces go within the circle and you won't go far wrong.

The green wiggle. Autolite has been latest getting into the field but the final result is a scope with intriguing abilities.

[Continued on page 226]

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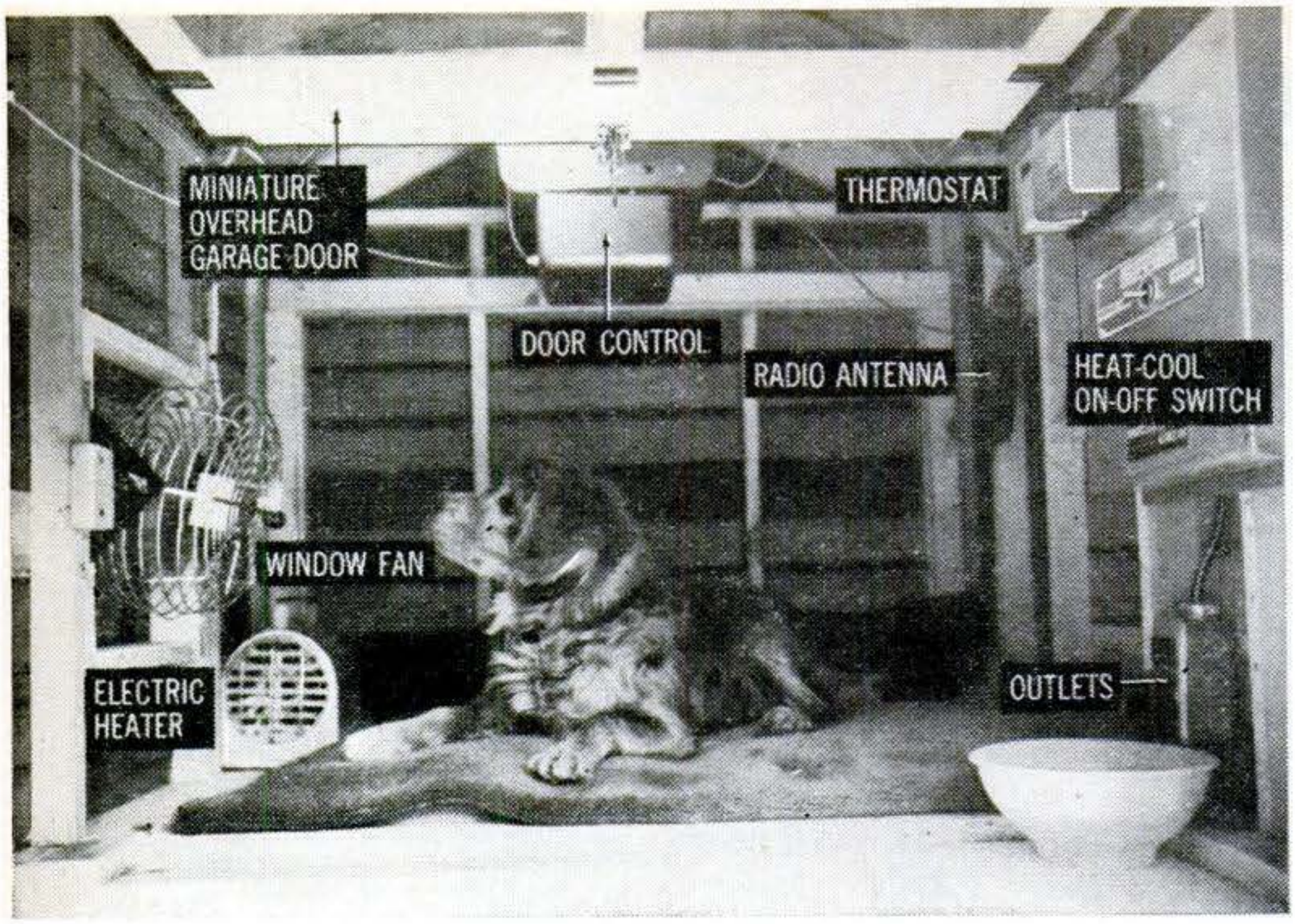


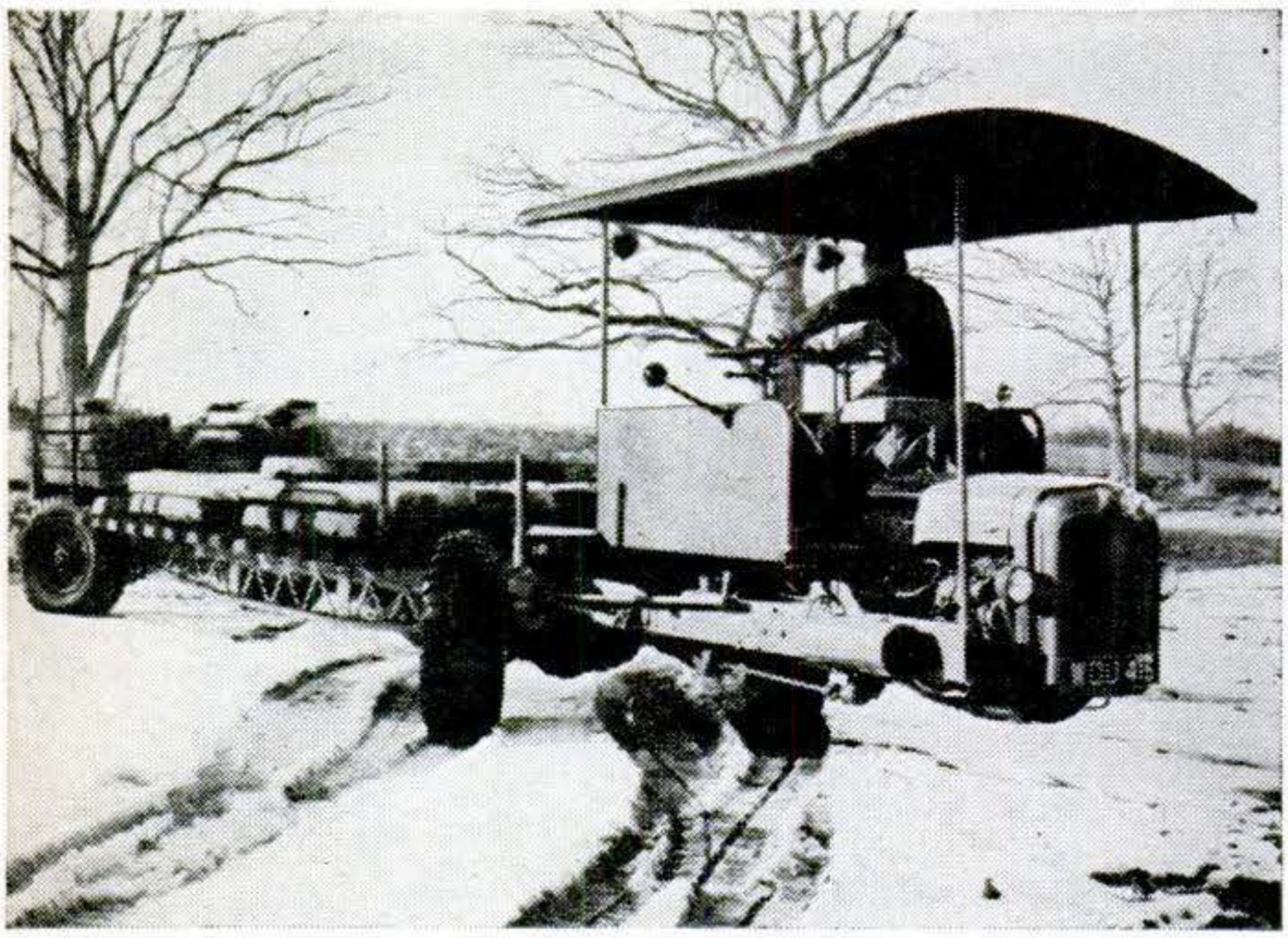
Pushbutton life makes Genie, above, a gay dog.

Paw on pushbutton . . .

. . . opens the door.

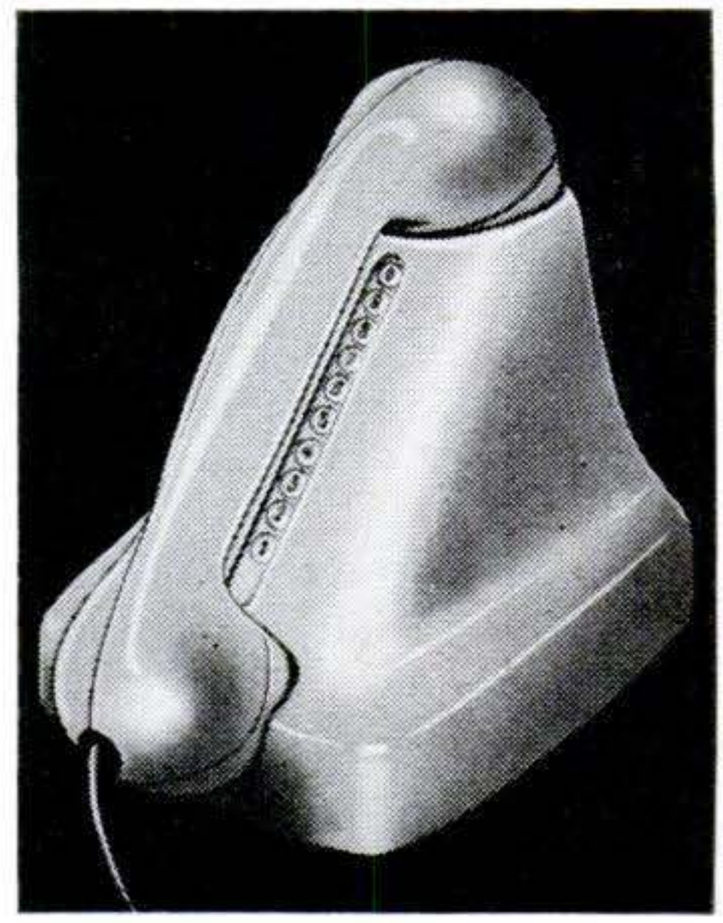
Electronic doghouse pampers pooch

Here's a new doghouse with all the comforts of the master's home—and more. By pawing a button at the threshold or another inside, the lucky dog can make the overhead door glide open or closed. Outside, he can operate it by barking a command into a radio transmitter in the yard. There's a thermostatically controlled window fan for warm weather, an electric heater for cold. Mechanics for Alliance Mfg. Co., Alliance, Ohio, who built it for demonstration at fairs and trade shows, plan to add still more gimmicks: an intercom system between dog and master and a set of bitch pin-ups to decorate the walls.



Big truck moves like a crab

This 41½-foot vehicle runs forward and backward, sidles, and turns in a circle little more than its length. The huge transporter was built by Walter H. Simmons and two employees of Simmons Engineering, Southampton, England. It has two steering wheels: one for the front axle and one for the rear. The latter can be locked for normal use on regular highways.



Dialing by tape

With this phone, you poke a finger into number wells on a vertical strip and pull them downward. This moves an endless tape that puts through the call. The West German inventor claims it's faster and surer than dialing in circles.

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Why Not Project All Your Photos?

ORIGINAL NEGATIVE was 2¼" by 3¼". It was cropped, to make slide being projected at top, with no loss of important detail.

Here's how to turn your prized black-and-white pictures into slides to fit a home projector

By Everett H. Ortner

I'VE discovered how to bring the happy scenes recorded in my old black-and-white pictures back to life again. The secret: I convert those old negatives to positives and make them part of my regular slide show.

It's a great thrill. Details and faces that you had never seen on the small family-album prints leap into sparkling existence. Your first car—remember it? or perhaps your father's first car, or your

CONTINUED

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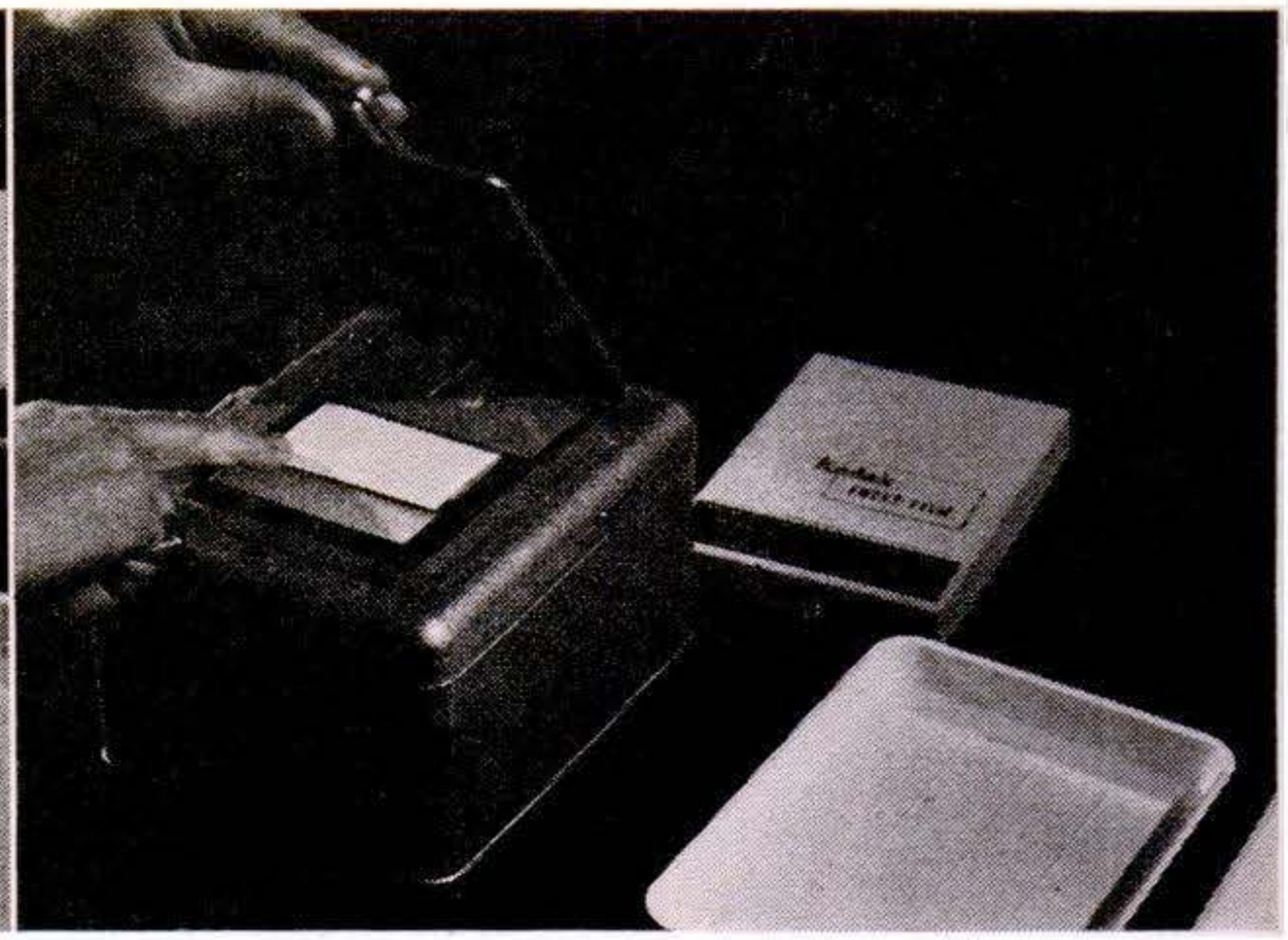
Contact printing makes black-and-white slides in minutes

NEGATIVE IS PUT IN CONTACT PRINTER first, just as in making paper prints. A mask of black tape, representing the final slide area, helps you pick the best part of a larger negative.



FILM GOES DOWN ON TOP of the negative and the printer's lid is closed, turning on the exposure light. After about two seconds, the film is removed and placed in developer.

grandfather's—gleams in all its proud glory on the screen. Friends, some long gone, reappear, almost life size.

And the wonderful part: Projection is absolutely fuss-free. The pictures go in your projector just like color slides.

How do you convert your old black-and-whites? Some film-processing outfits will make black-and-white transparencies for you, but at a fairly steep price. I found that you can do the job yourself for pennies with very little equipment.

The method is simple. It's just like printing a negative in the ordinary way except that, instead of using paper, you substitute positive film. When the film is developed, it produces a black-and-white transparency that can be shown in any slide projector.

If you have the negatives of your black-and-whites, you can work directly from these. Where you have only prints, you can have copy negatives made by a commercial processor. You then need only the film and a means of exposing it. To develop the film, you use exactly the same simple chemicals and procedures as for developing paper prints.

Two ways you can use an enlarger to make transparencies

PROJECTION PRINTING: Big negatives can be reduced to slide size on some enlargers by projecting them this way. Film must be blocked up on books or a box to bring image into focus.

CONTACT PRINTING: Using an enlarger as a light source, you can print several negatives at a time, like this. Place negatives on film under glass. Exposure here was about six seconds.

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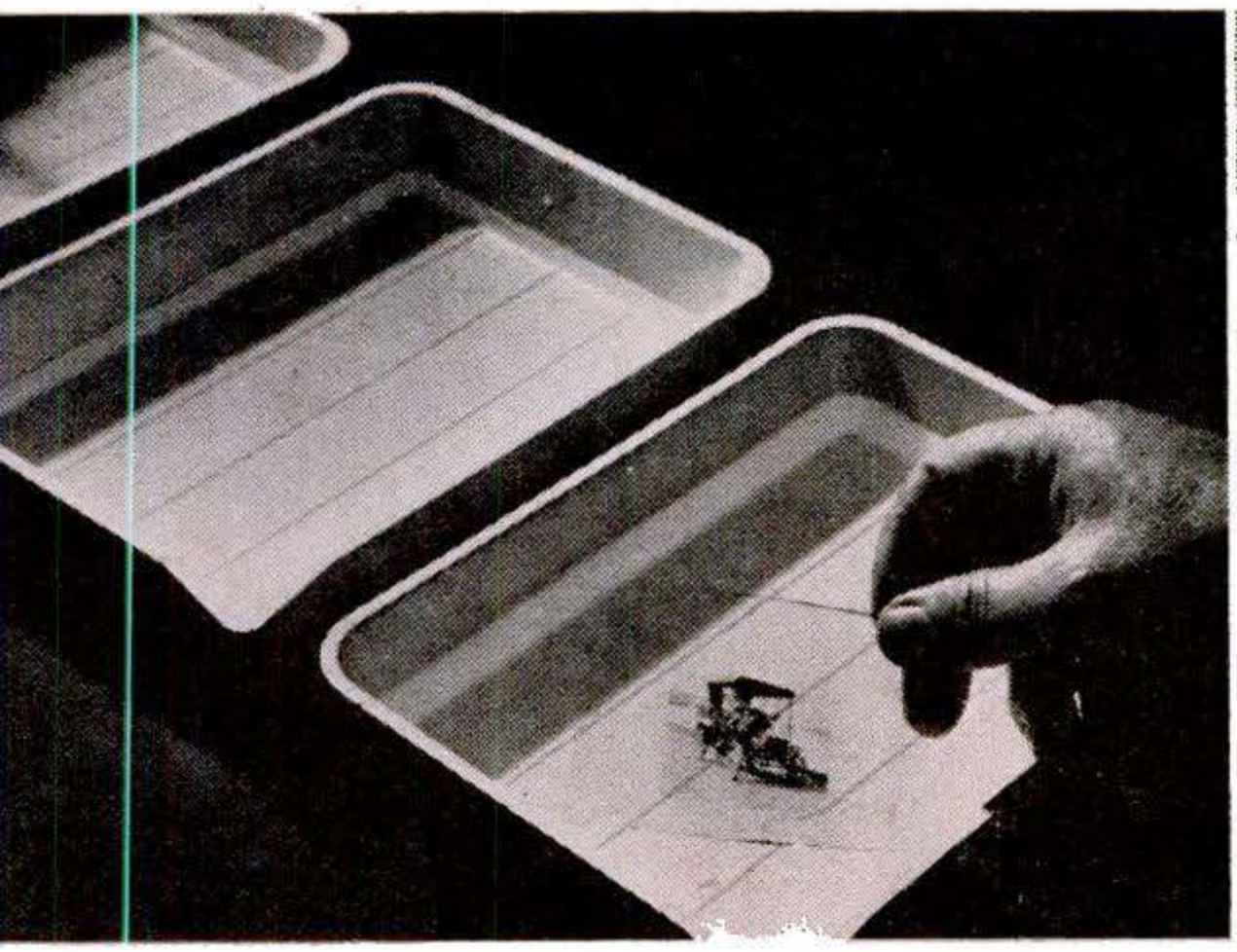
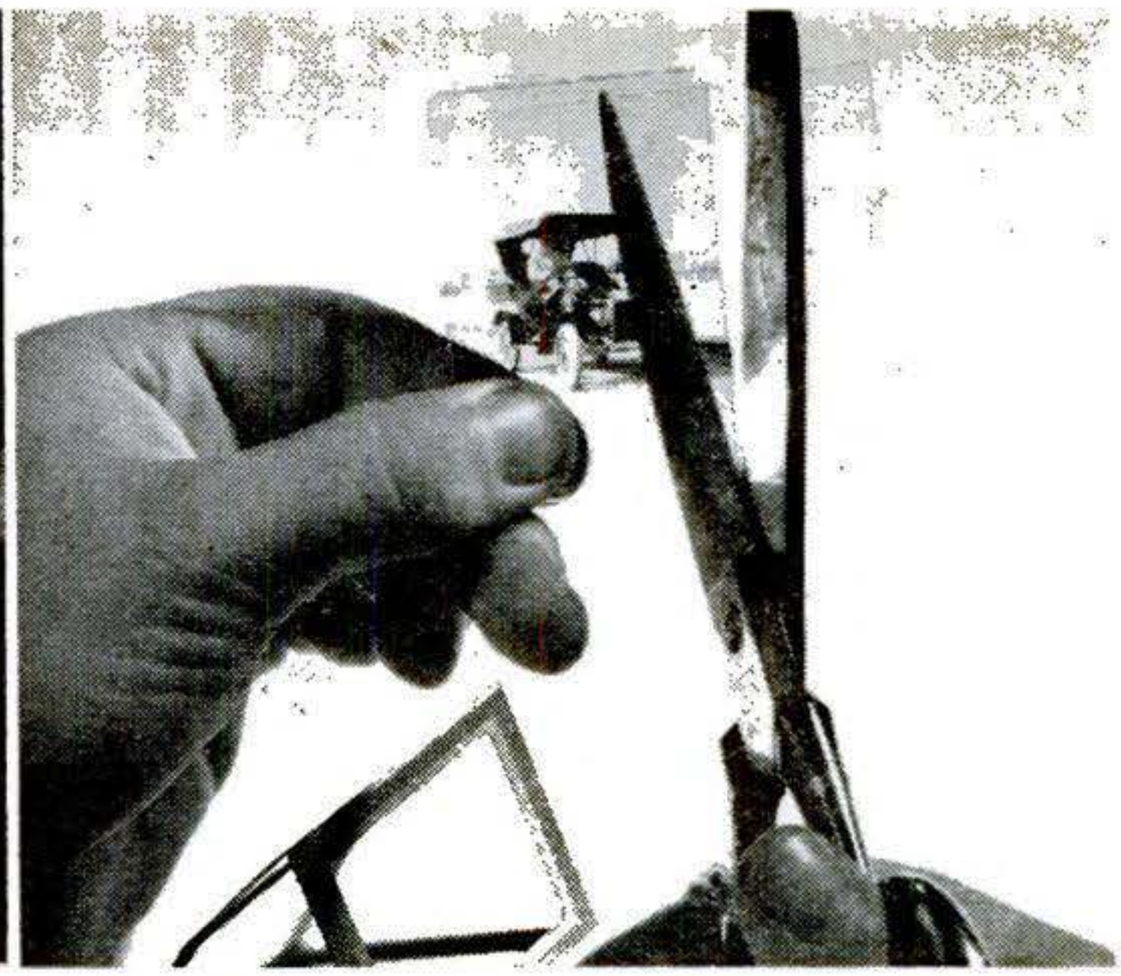


IMAGE APPEARS almost immediately as film is placed in developer. Using white-bottom trays enables you to see the results instantly and make any necessary adjustments in exposure.



PLASTIC TRIMMING GUIDE comes with most slide mounts, helps you cut transparencies to correct size. Cardboard mounts are folded over the film and sealed with a household iron.

You get better pictures, too. Black-and-whites take on sparkling new life when you project them onto a large screen. The positive film has a much greater tonal range than printing paper, and the result is an incomparably better picture that retains all the shadings and subtleties of tone of the original negative. And here's an extra bonus: By varying exposure and development times, you can improve on negatives that are thin, dense, or contrasty.

What you need. I used Kodak's "Fine Grain Positive Film." It comes in 35-mm. rolls 100′ long and in 5″-by-7″ and 8″-by-10″ sheets. The sheets are handier since you can cut them into any size pieces you need.

The sheets cost $4.80 for a box of 25 in the 5″-by-7″ size and about $10 in the 8″-by-10″ size. This works out very cheaply when you consider that you get enough film to make a good many hundreds of transparencies. Not all photo stores stock this film, but it can be ordered for you by any Kodak dealer. (If you can't locate a dealer in your area,

[Continued on page 216]

WHAT YOU GET: Superslide, shown actual size at center, gives you largest picture area. At right is 828-size mount and at left the smaller 35-mm. size.

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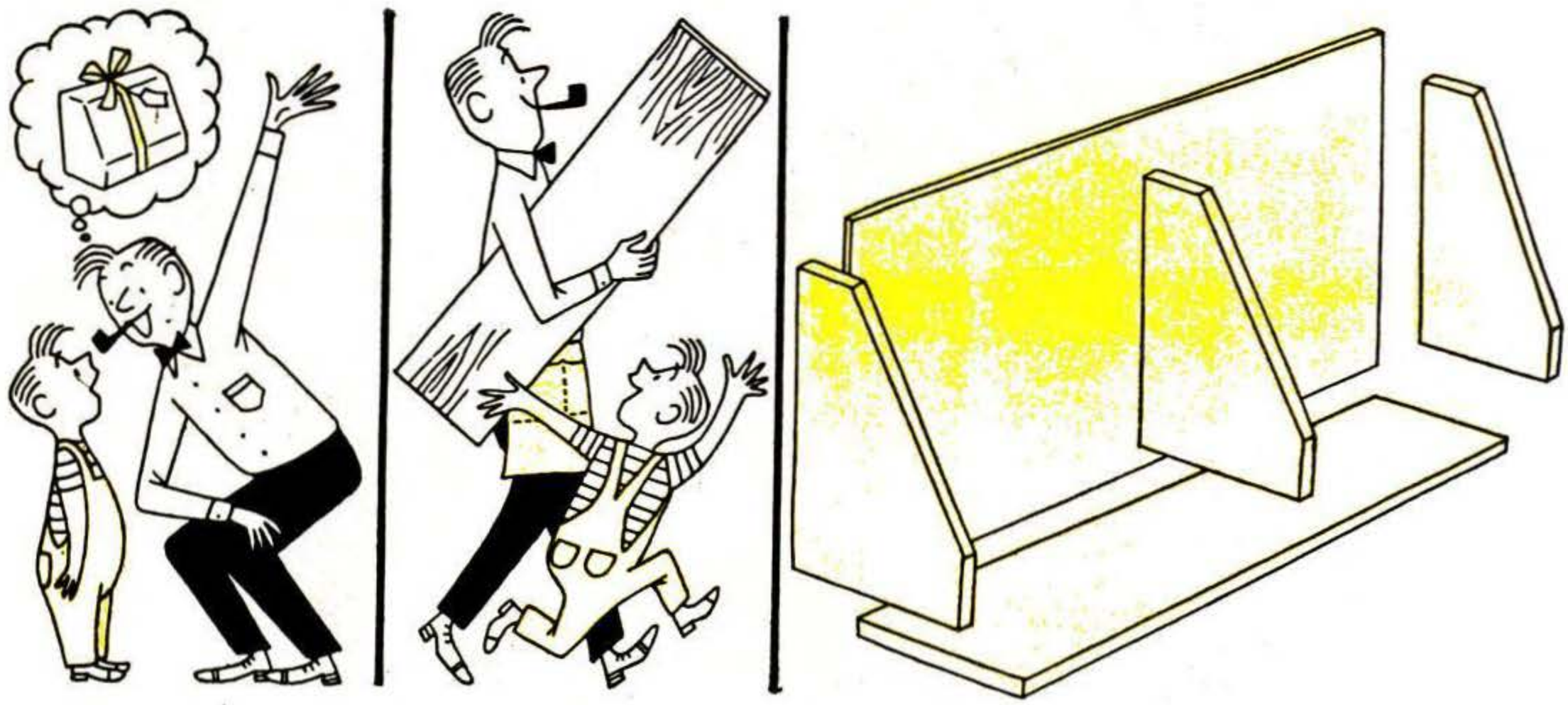
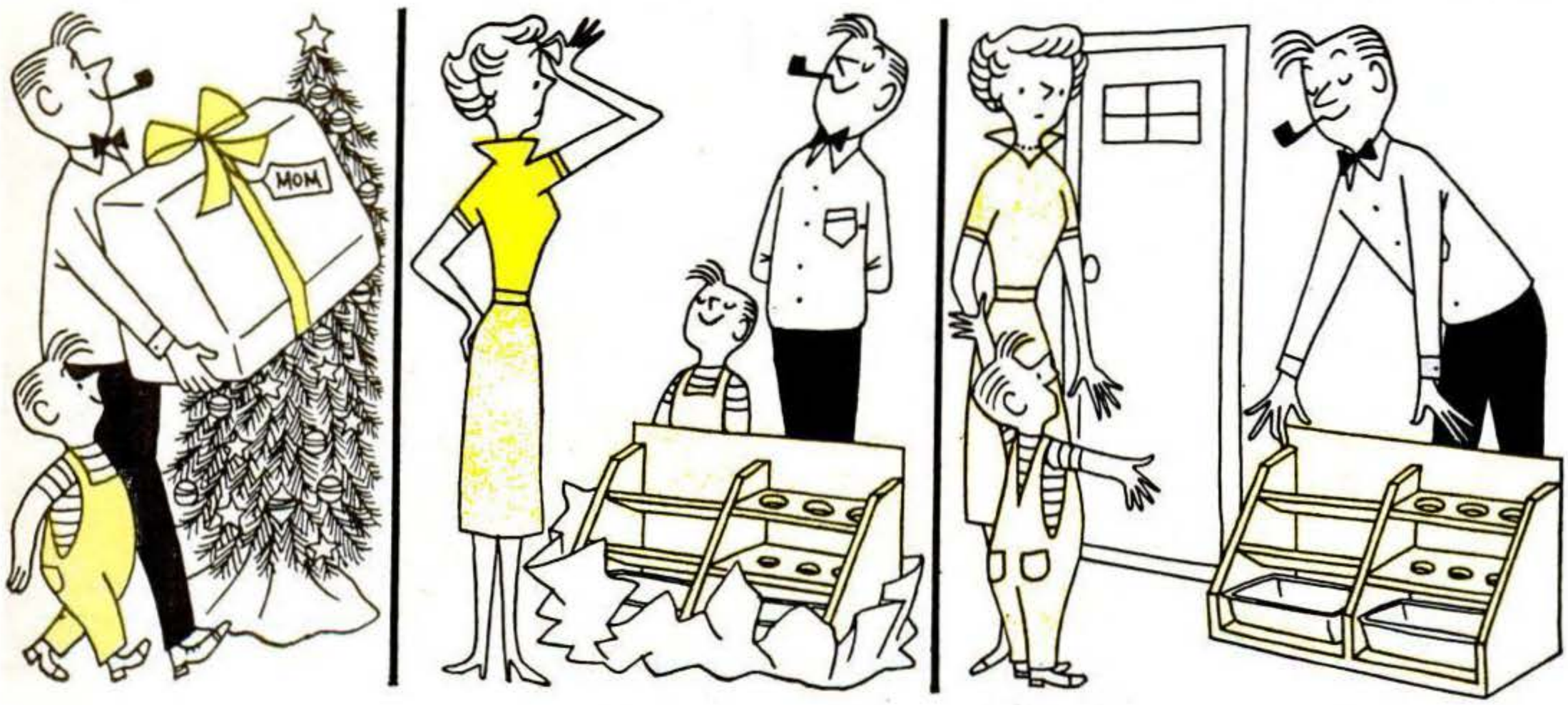
Wordless Workshop

By Roy Doty and John Mihalick





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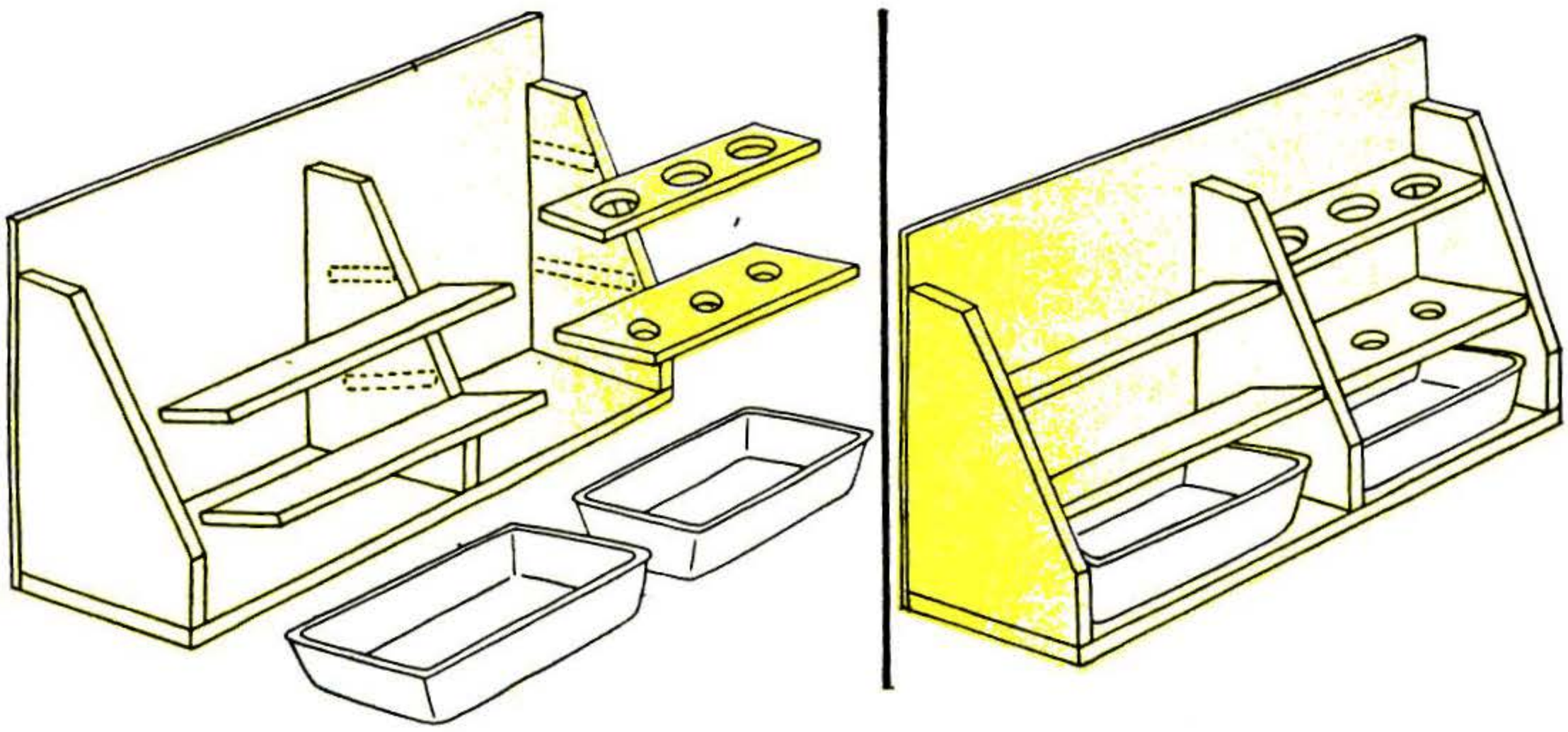

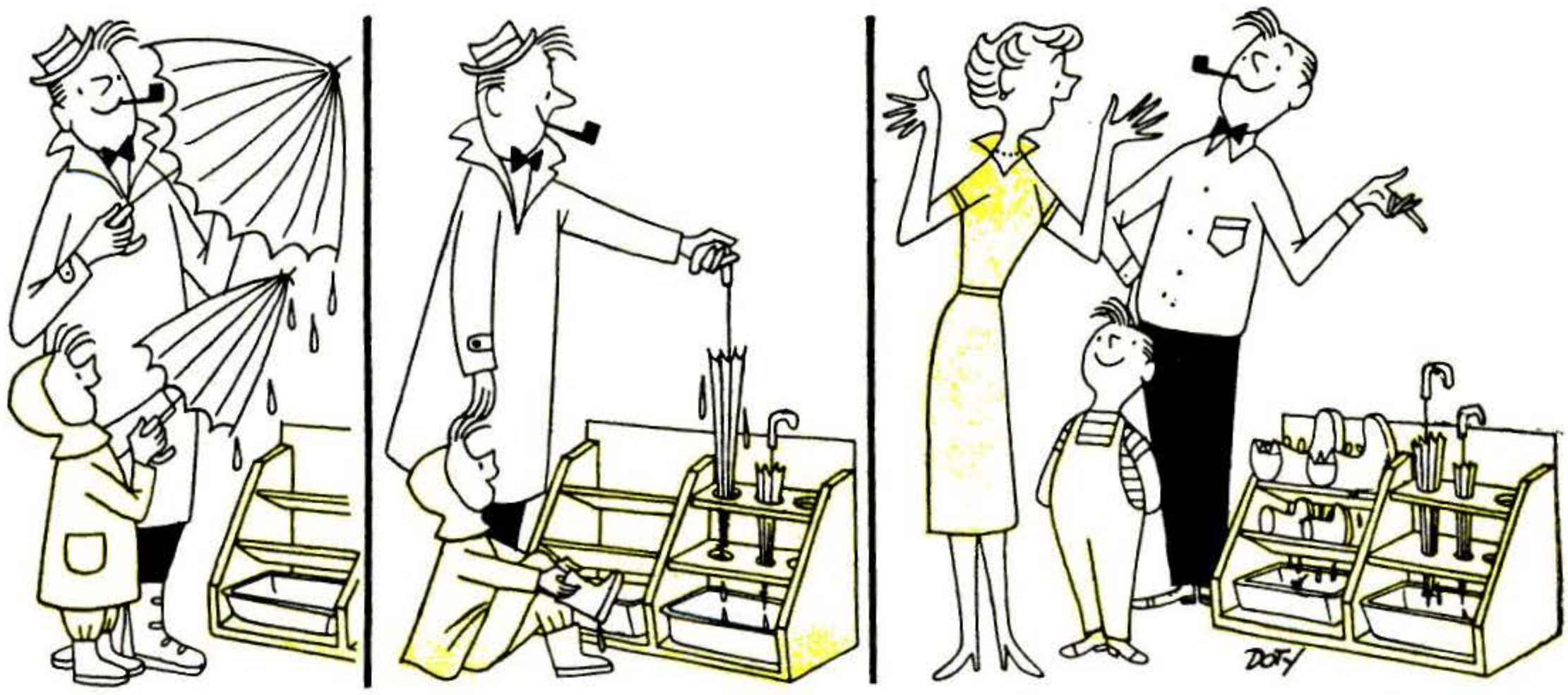

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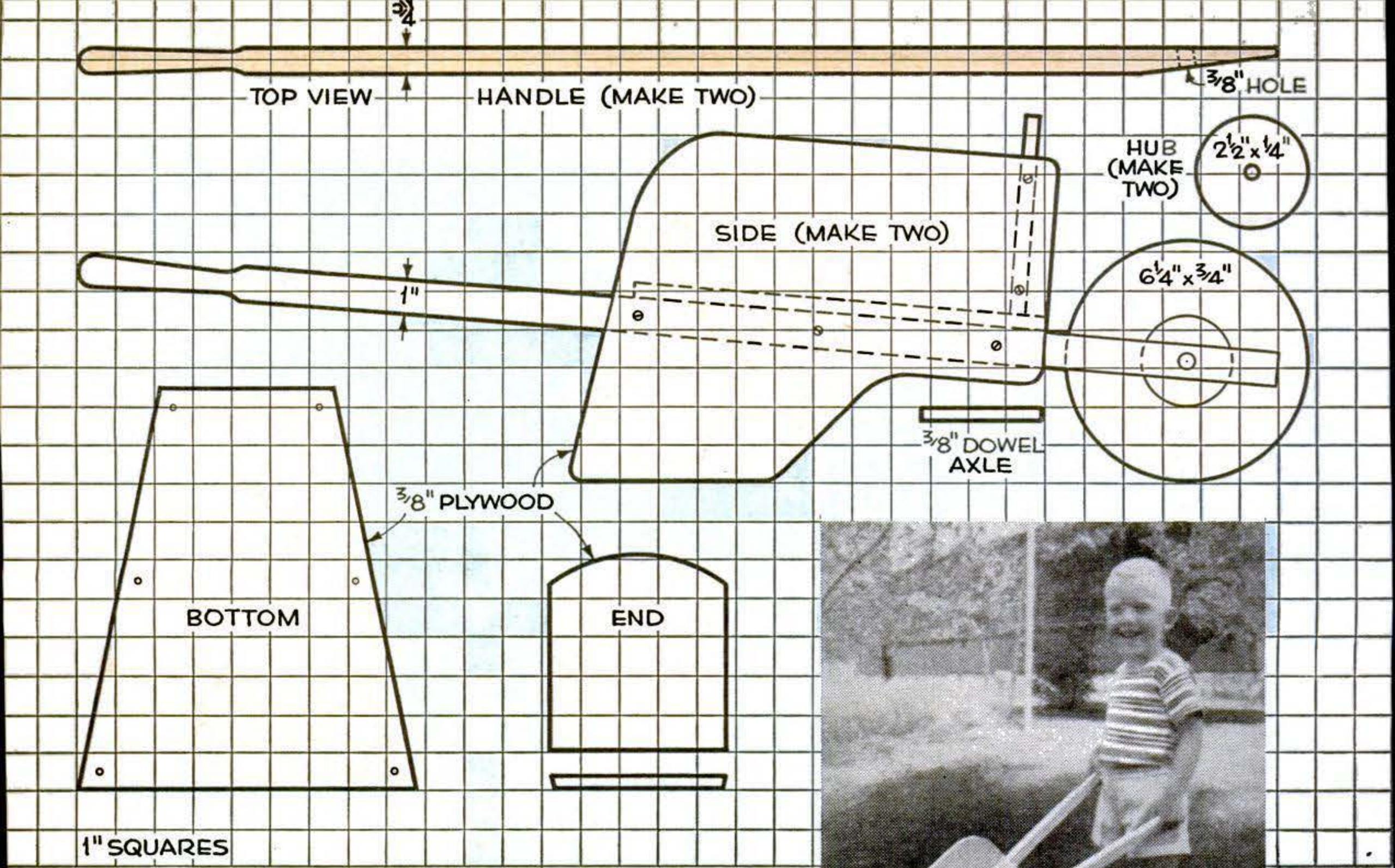

Toy Barrow Built to Last

By G. E. Hendrickson

IS THERE a boy from three to eight on your Christmas list? From an informal poll of gentlemen in this age bracket, I found that a wheelbarrow is the number-one gift request. Further research indicates that most toy barrows on the market may look nice under the Yule tree, but aren't likely to greet the New Year in one piece.

This custom-made job will take a beating. Yet it is so simple to build that you can cut the pieces for several barrows at once. The pilot model has stood up under severe road tests and is about to celebrate its fourth Christmas.

All parts are of plywood, except the handles. These are solid pine, ¾″ thick and 1″ wide, rounded at one end for a good grip and beveled on their inside faces at the other end. Don't drill for the axle until after assembly. From a ⅜″ plywood panel, cut the bottom piece first. Position it on the top edge of the handles so that, when its tapered edges are flush with the outer faces of the handles, the handles' end bevels form a slot with parallel sides.

Attach the two side pieces with their top edges parallel to the face of the bottom member. Bevel the vertical edges of the end board so that it fits between the sides. Use 1″ screws for assembly. Glue is optional here—but use it (or brads) to attach a hub disk to each side of the wheel. Drill a ⅜″ hole through the center of all three. Sand the dowel enough to permit the wheel to turn freely on it. Since this will also make for a loose fit in the handle holes, drive a screw into the dowel from the upper edge of one of the handle members. Then, should the dowel become worn from constant use, it can be easily replaced.

Contrasting colors of enamel—and perhaps the owner's name lettered on the side—finish this gift project with a flourish. If you prefer the natural wood, brush on several coats of spar varnish.

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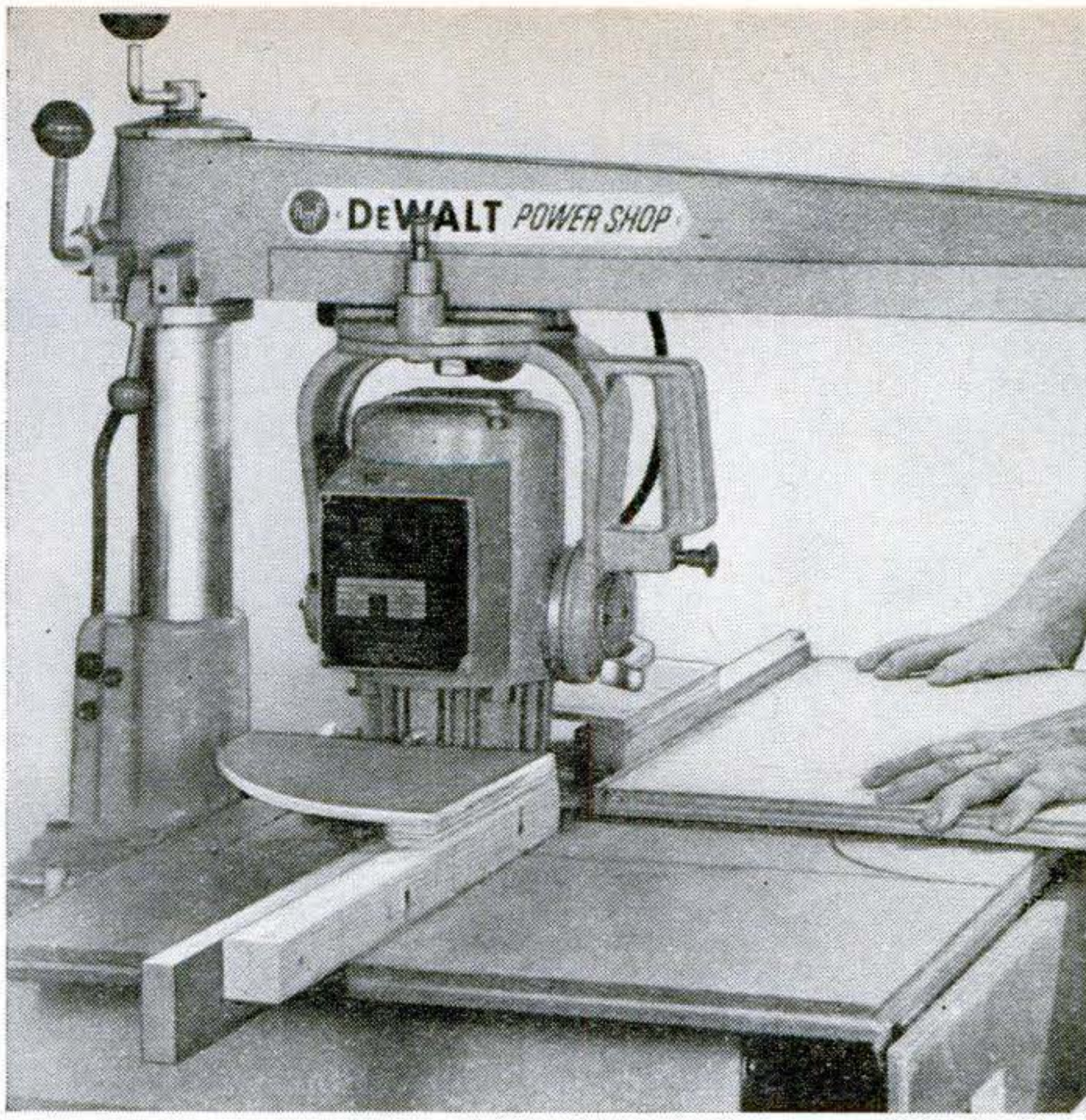
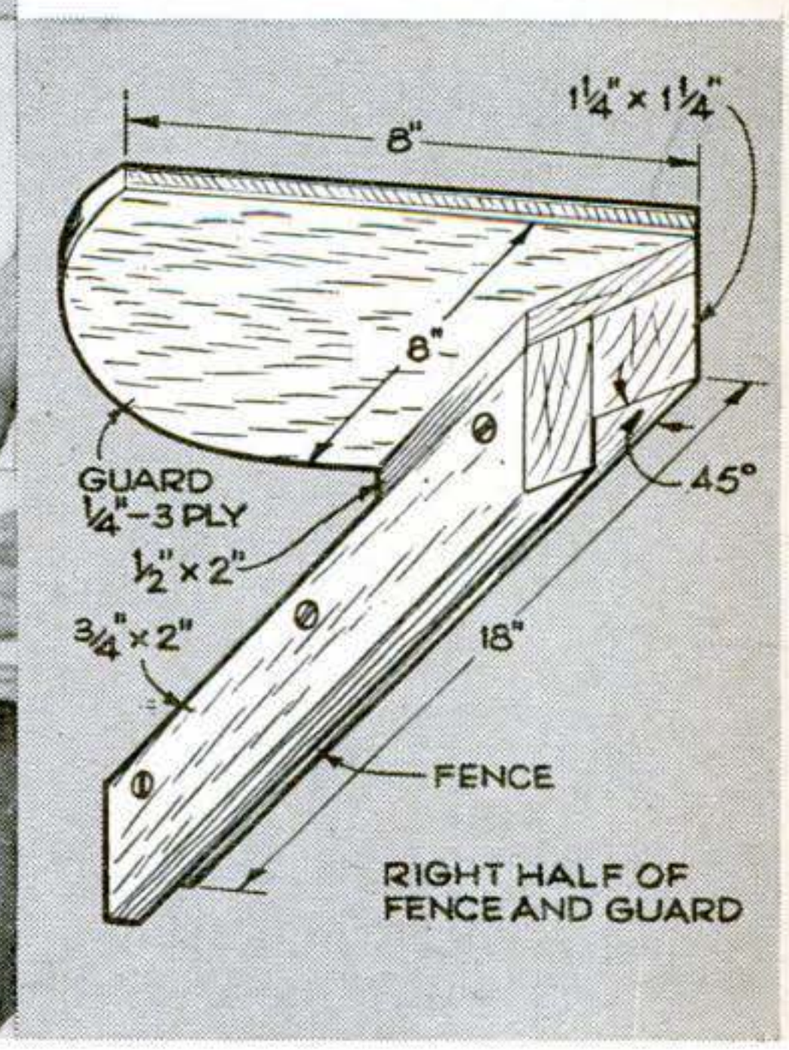
Short Cuts and Tips

FROM PS READERS

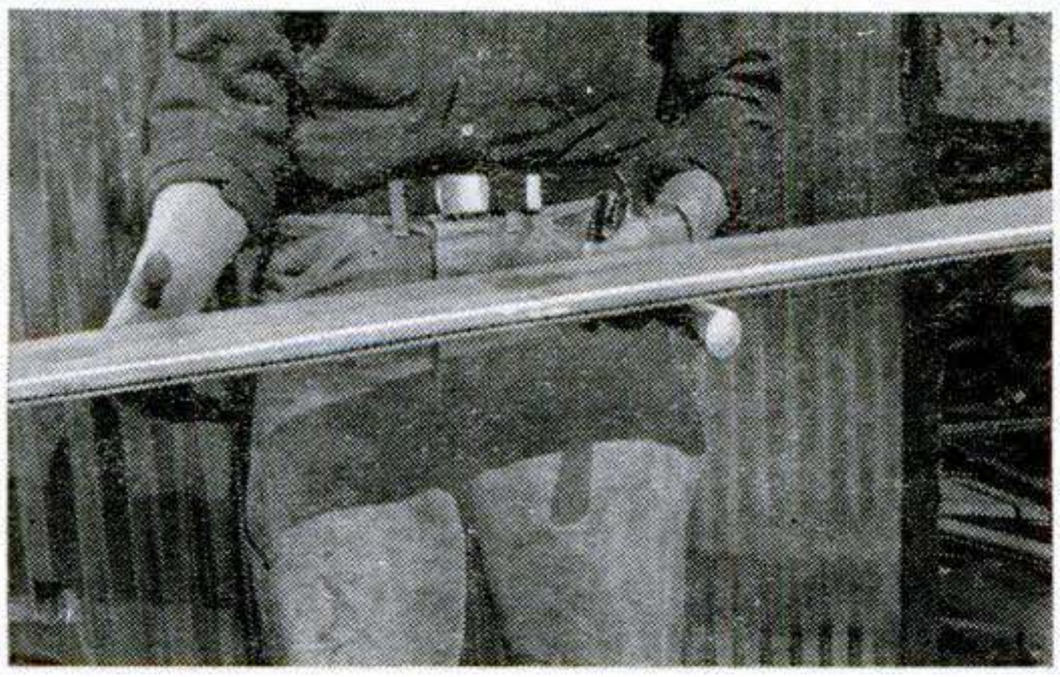




A Rabbeting Fence and Blade Guard for a Radial Saw

CUTTING narrow rabbets on the edge of a panel (to form a lip on cupboard doors, for example) is a quick, two-pass operation with a radial-arm saw. The depth of the vertical cut is easy to set, but when you switch the blade to a horizontal position, you must bring it far forward to clear the column base. This causes the blade to project too much beyond the fence. Substituting this special fence solves the problem and also provides a guard for the naked blade. It consists of two halves—identical except that one (sketch) is right-hand, the other left.

The vertical members replace the standard fence in the table slot. The 1¼"-square pieces that rest on the table extend the face of the fence. The blade nut enters a square hole in the table.—*Edwin M. Love, Palmdale, Calif.*



What Would You Do ?

. . . if you had to cut a board in half— and lacked a measure?

An old carpenter's trick is more accurate than guessing by eye alone, and faster than other makeshifts. Just balance the board on anything handy. Cut at the point of balance.

Darrell Huff, Pacific Grove, Calif.

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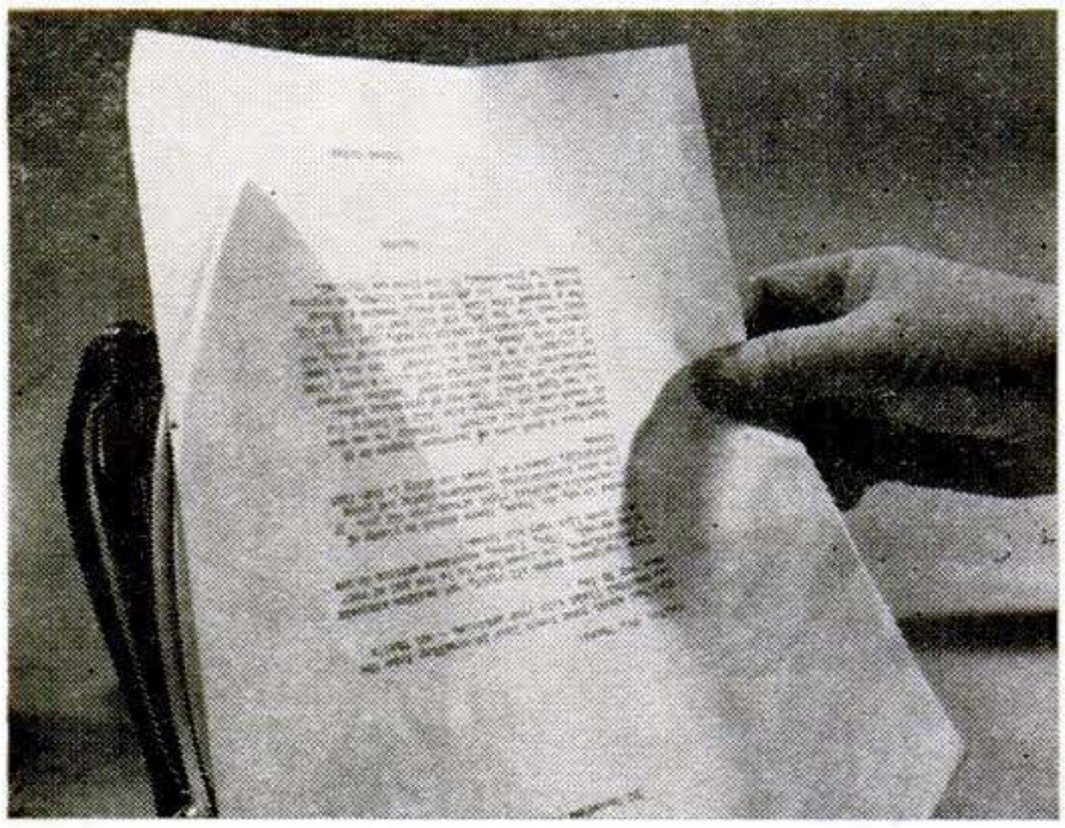
Short Cuts and Tips

FROM PS READERS

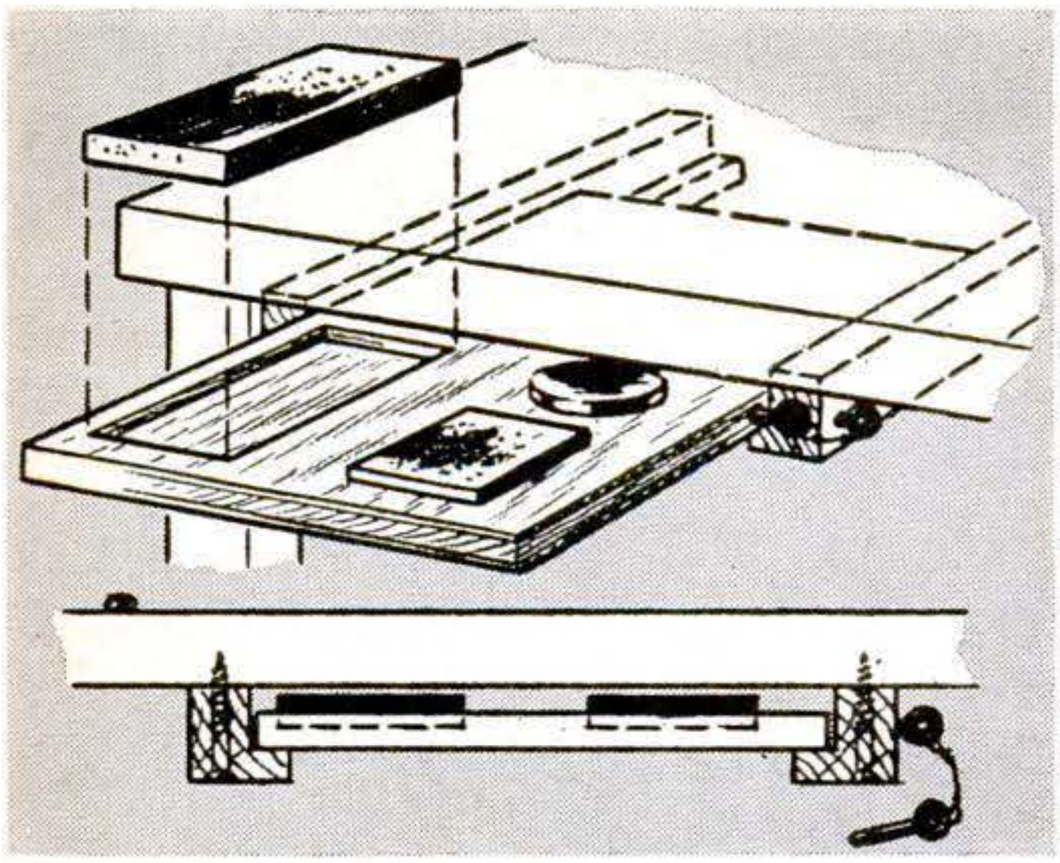


Heat Salvages Carbon Copies

EVER type a whole page before discovering that you'd used carbon paper so badly worn or of such poor quality that your copy was barely legible? Try holding the back of the page against the face of a warm iron. The carbon particles melt and fuse, darkening the faint impression.—*Ken Murray, Colon, Mich.*

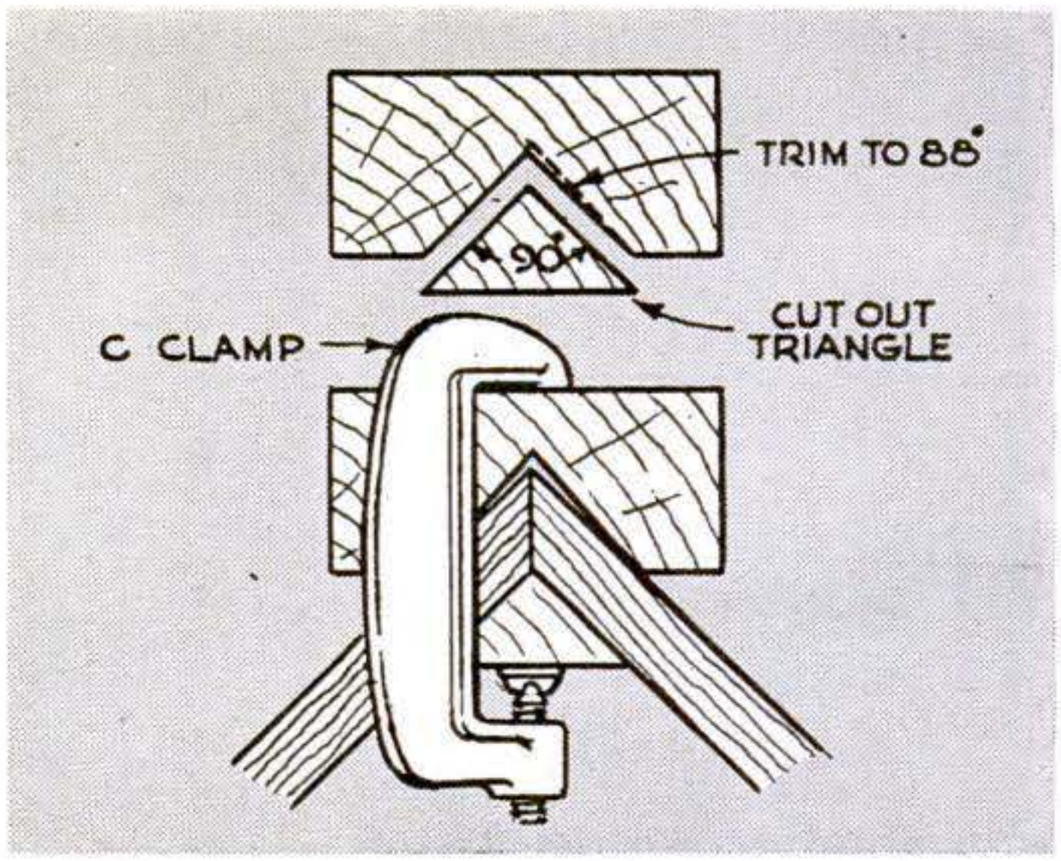
Shoe Scraper from Old Andiron

NOTHING seemed more useless than the spare andiron left when the other half of our pair burned out. But, rather than discard it, we cleaned and painted it and fastened it to the porch step. Now it serves as a king-sized scraper to keep the family from tracking dirt into the house. —*R. M. Woodbury, Natick, Mass.*



Work Board for Oilstones

TO SPARE sharpening stones from damage and keep them clean, they should be exposed only when in use. They'll always be handy if you recess them into a pull-out board that slides beneath the workbench on L-block runners. When it's in working position, insert an eyebolt in a predrilled socket to keep the board from sliding back as you stroke the stones.—*Daniel Bousha, Jackson, Mich.*



Blocks Speed Corner Clamping

A MITERED frame can be clamped accurately and quickly with these corner blocks cut from four pieces of scrap. The small triangle aligns the two parts forming the corner, while the outer V-notched block forces them together with the pressure of a single C clamp. Put waxed paper between the blocks and the work to keep glue from sticking.—*R. E. Nelson, Vandenberg AFB, Calif.*

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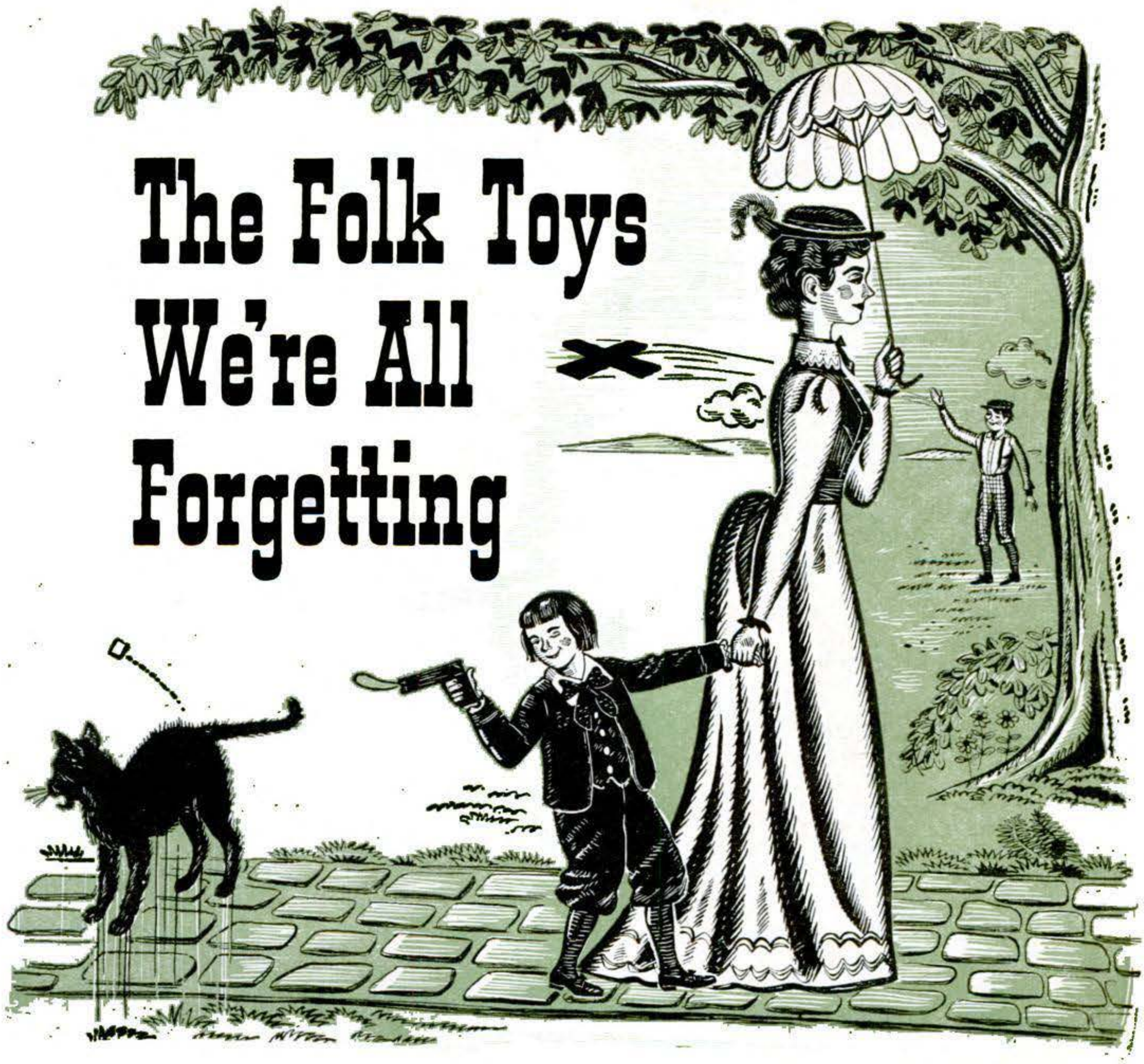
The Folk Toys We're All Forgetting



By Harry Walton

FAST being lost in this age of plastic playthings are the homely toys kids used to make for themselves. They didn't look like much, but they sure were fun. They shot, spun, ran, flew, snapped, and did other fascinating things.

You learned about them from other kids. A boy would show up with something *he* had learned to make from another one, and in a matter of hours every kid in the neighborhood was trying it.

But something has happened to this chain of communication. Those homemade folk toys are being forgotten. Grownups don't seem to remember them. Most kids never heard of them.

A grownup who does remember, Robert Paul Smith, wrote a book about them called *How to Do Nothing with Nobody All Alone by Yourself*. It must have jogged many memories, for it soon became a best seller. But probably many adults who read it remembered, as I did, a lot of toys that weren't in the book.

What's wonderful about folk toys is that they're almost a racial memory. You'll never know who invented the rubber-band stern-wheeler, or willow whistles, or slingshots. Probably it was several people in far-apart places—and I'd bet some of them were boys.

Making such things began with scrounging the materials. To make a boomerang, we wangled an egg crate or fruit box from a store and knocked off the thin sides. No Australian aborigines would have recognized the result, but thrown hard overhand, it skimmed speedily. If you pitched it at just the right angle, the thing would fly up, swing around, and seem to glide down an invisible hill back toward you.

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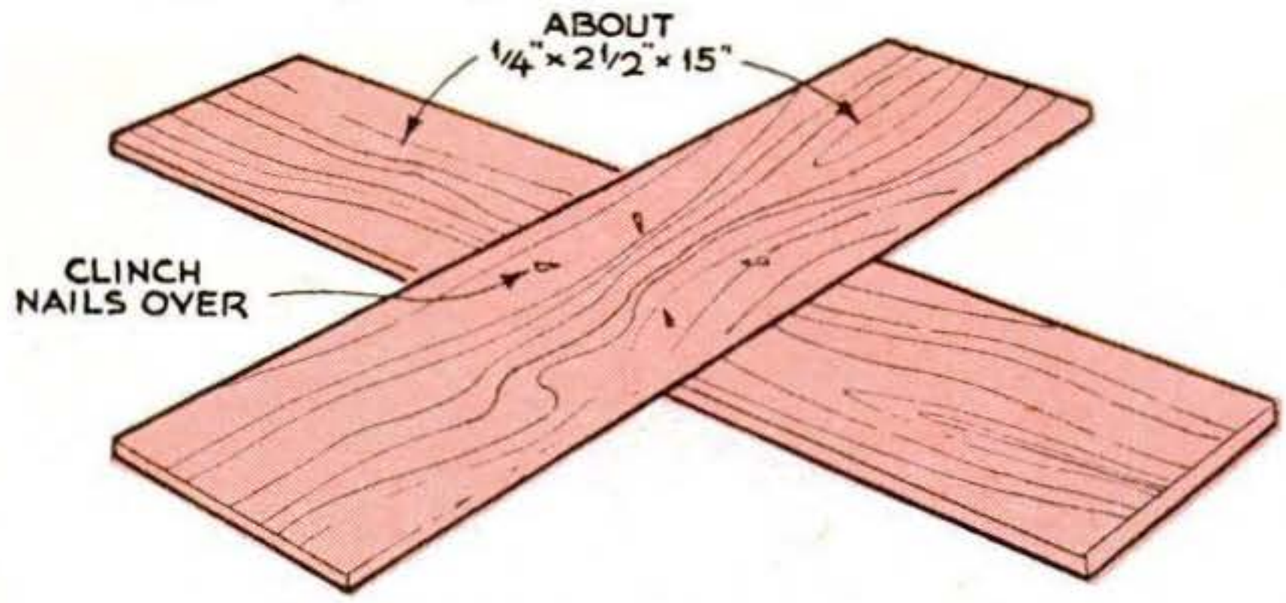
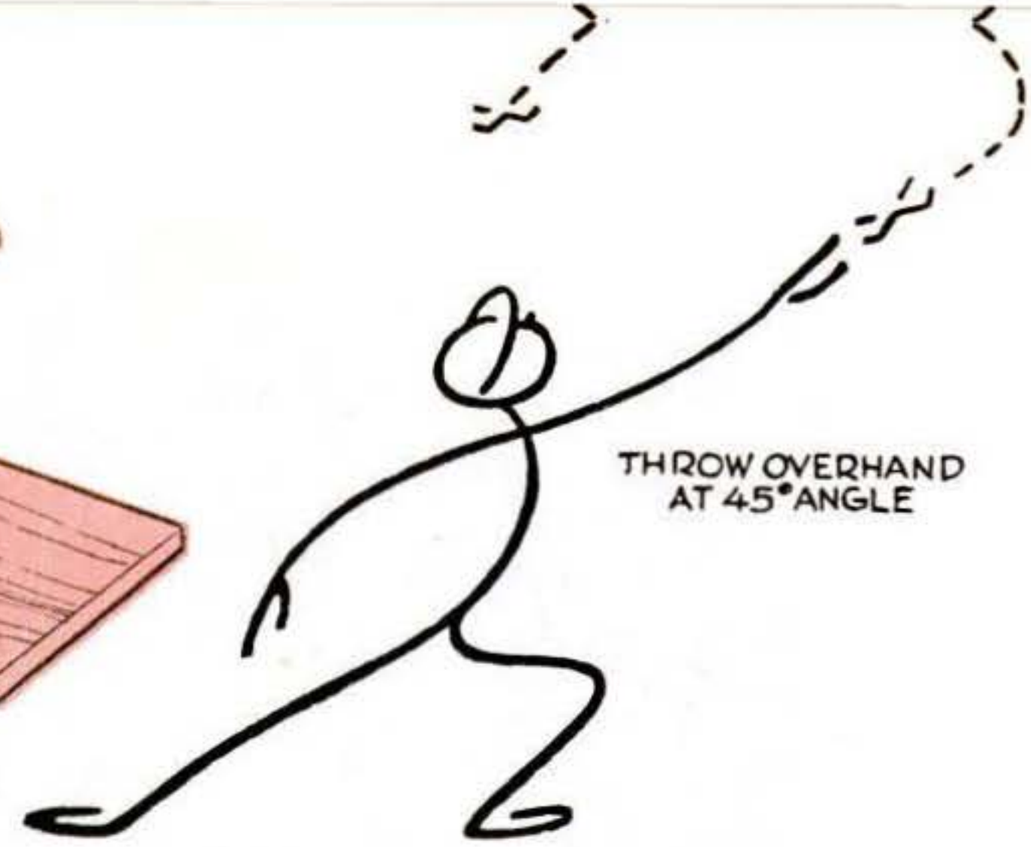
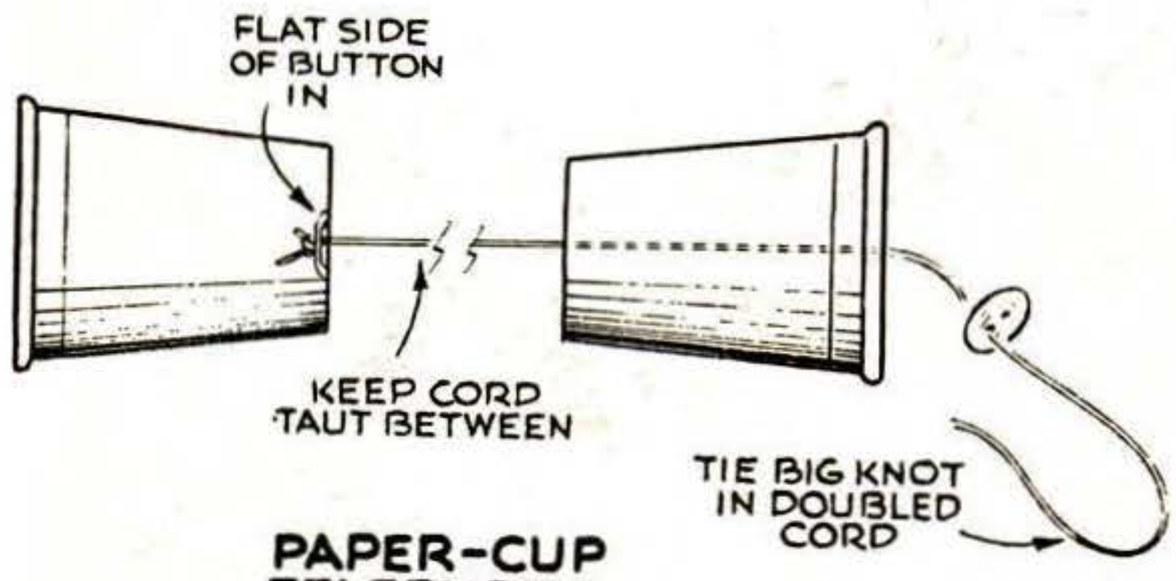
Folk Toys Any Boy Could Make

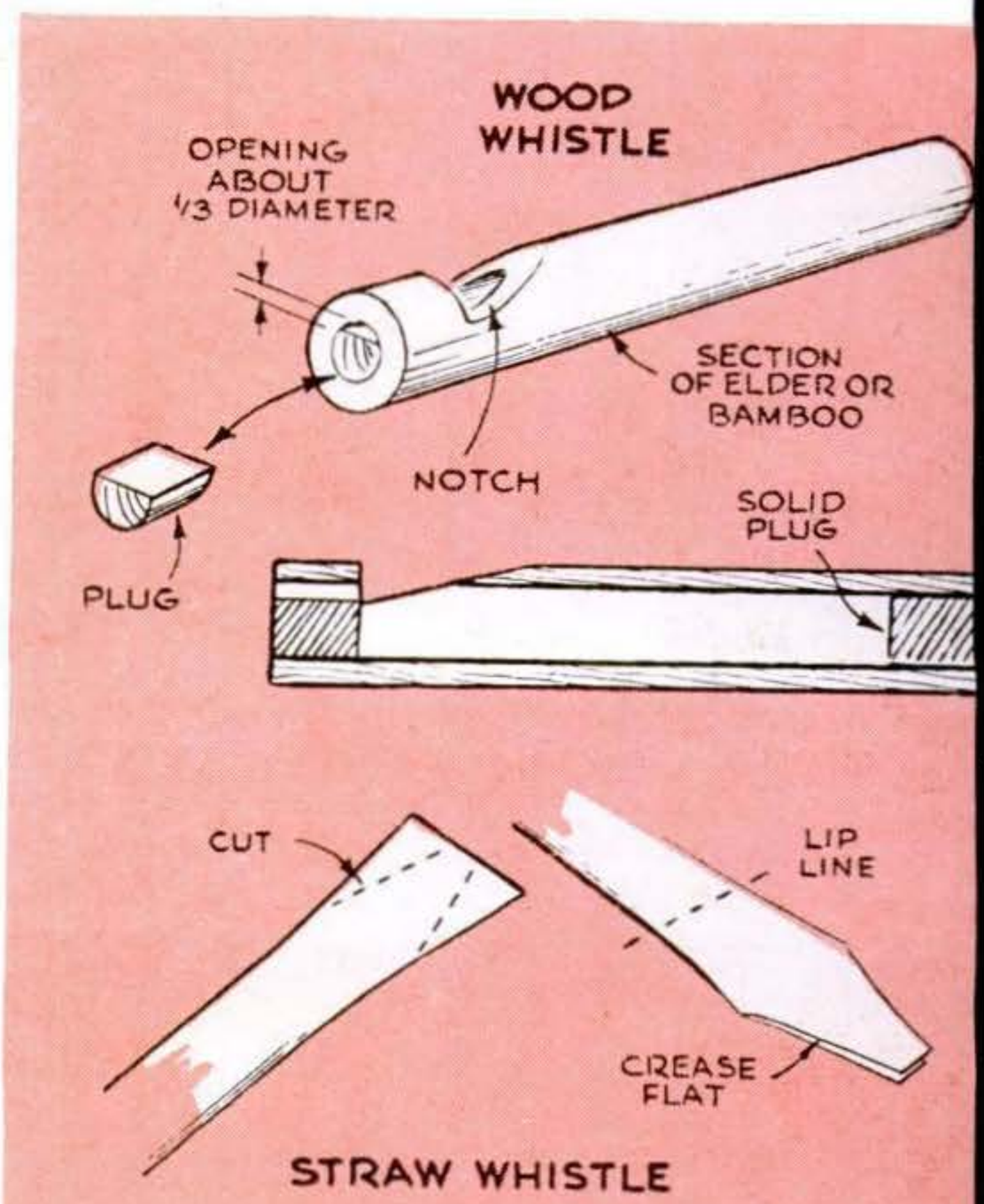


CROSSED-STICK BOOMERANG



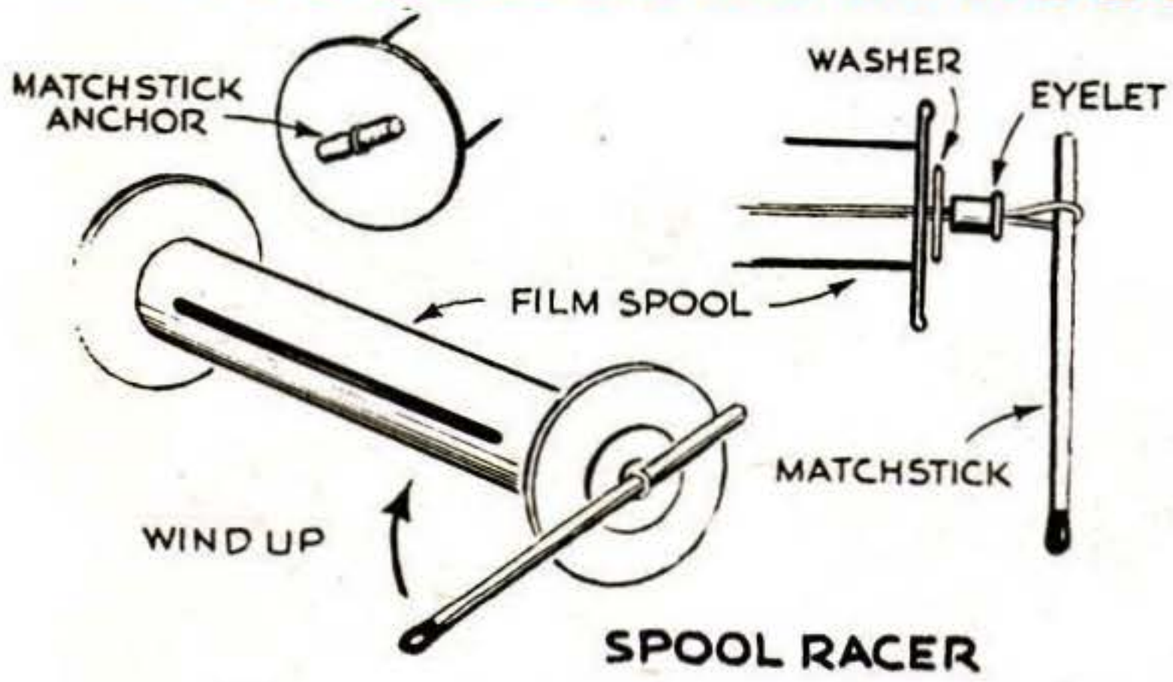


PAPER-CUP TELEPHONE

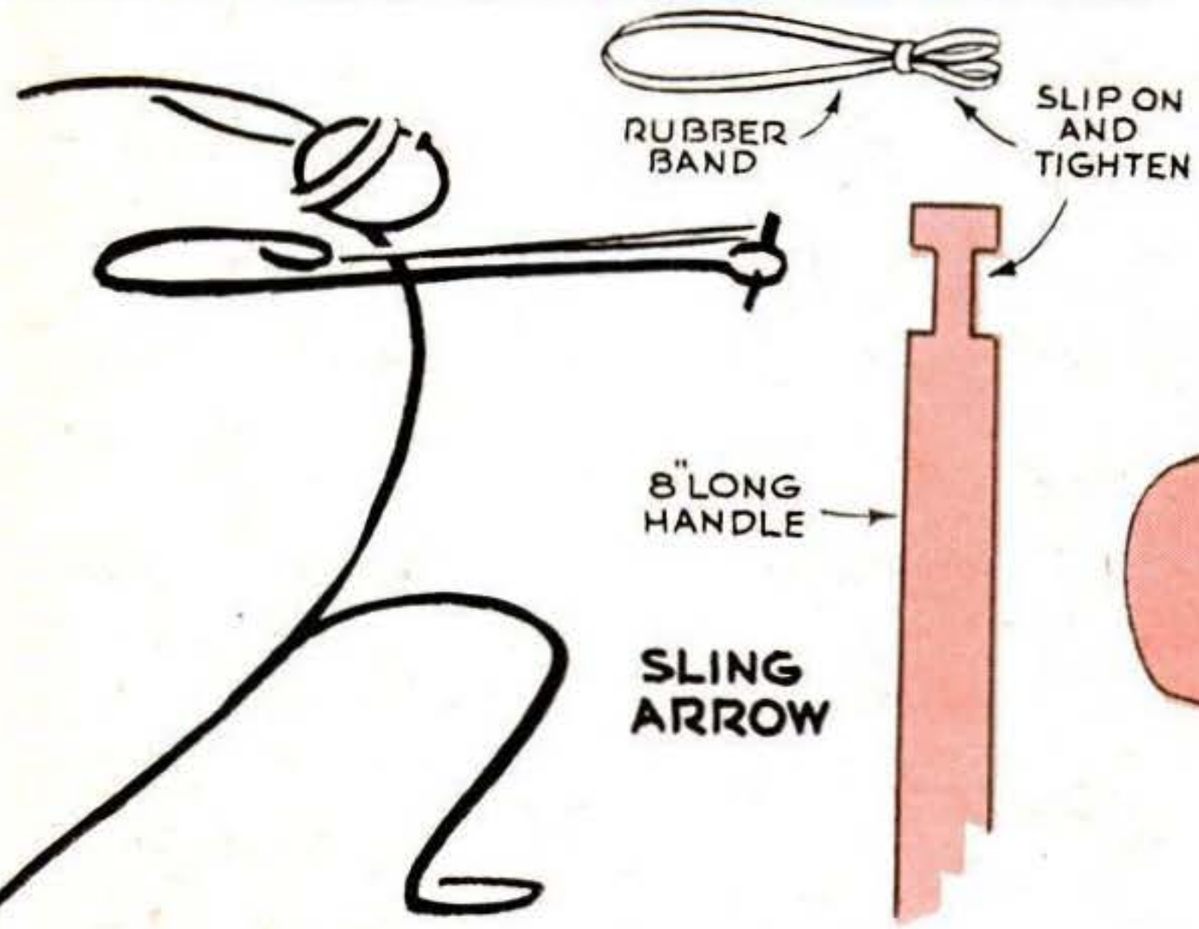


STRAW WHISTLE

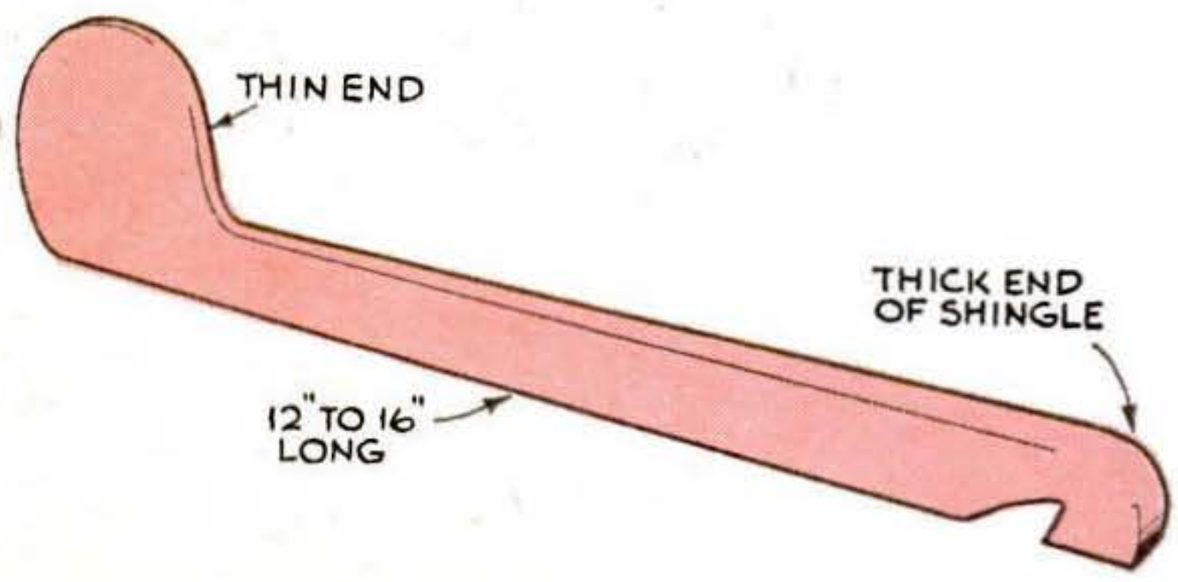
STRAW FLUTE



SPOOL RACER



SLING ARROW



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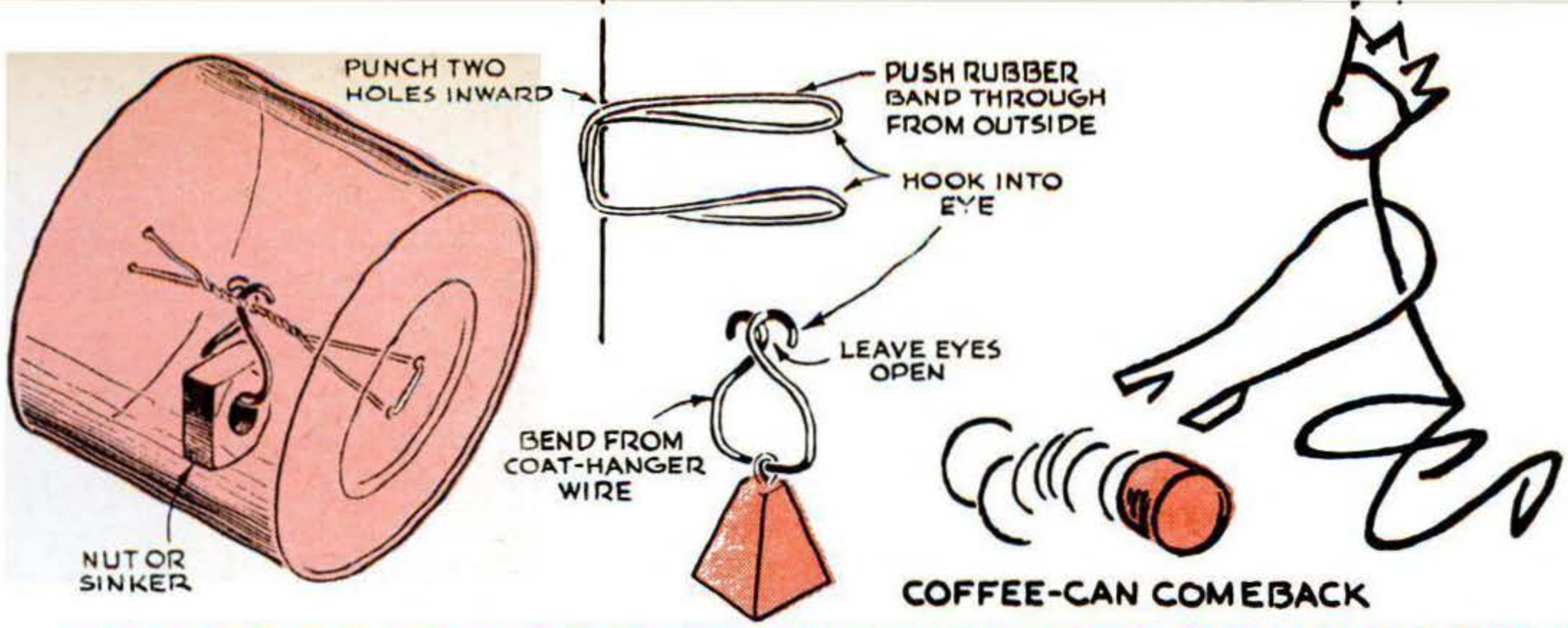
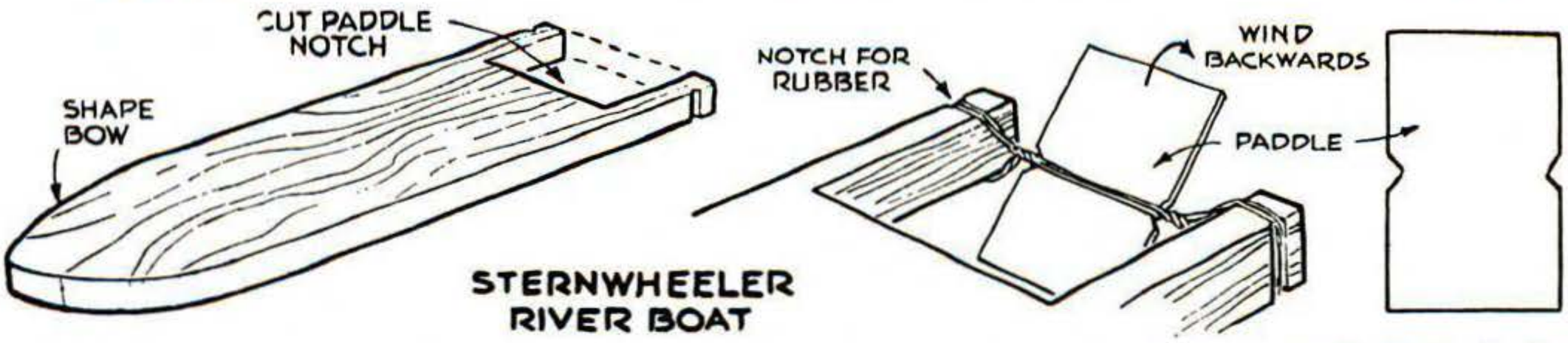
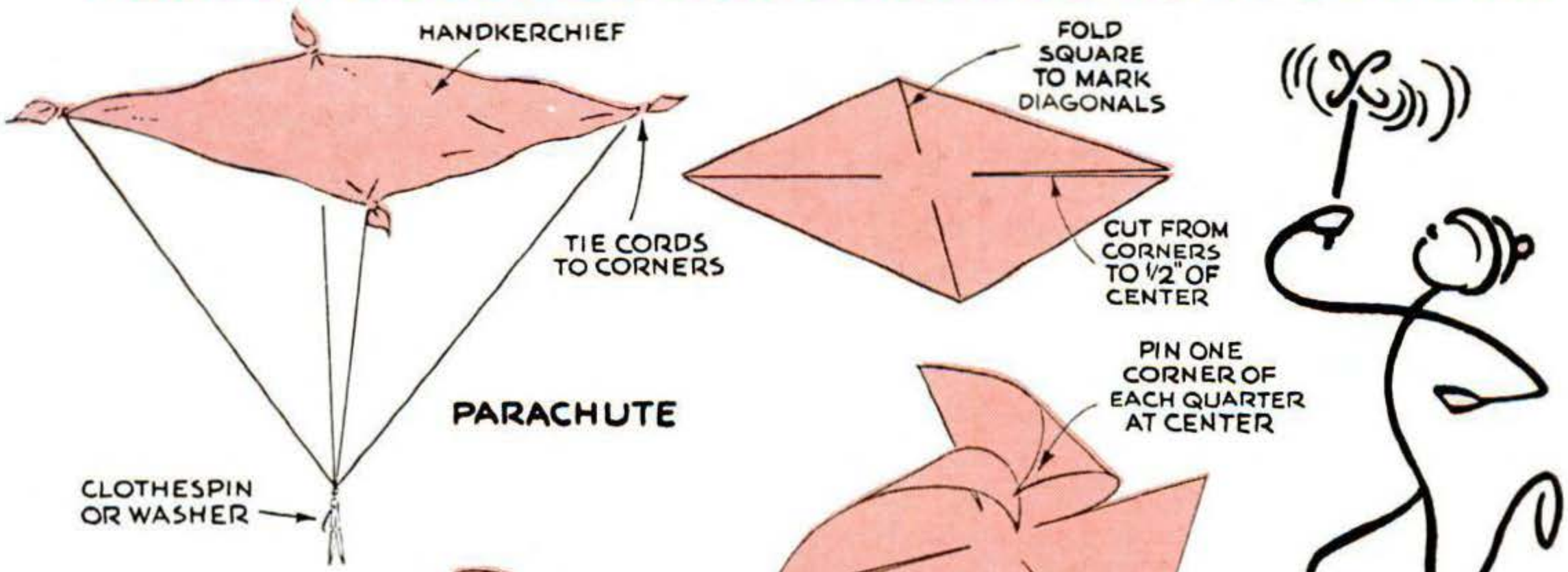


COFFEE-CAN COMEBACK

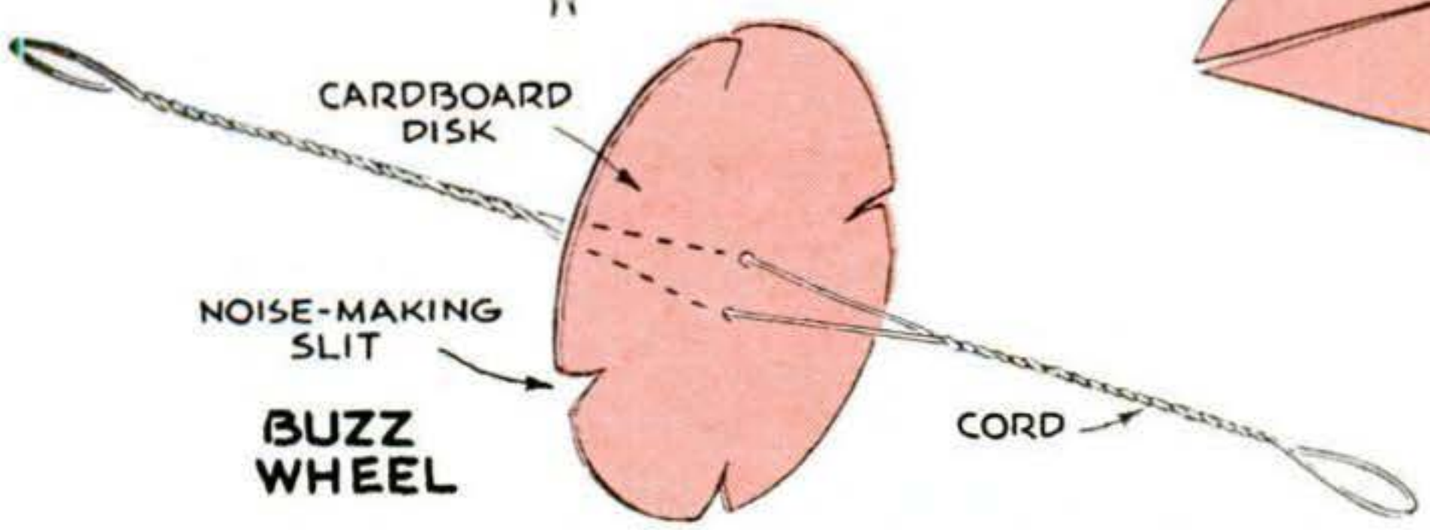


STERNWHEELER RIVER BOAT

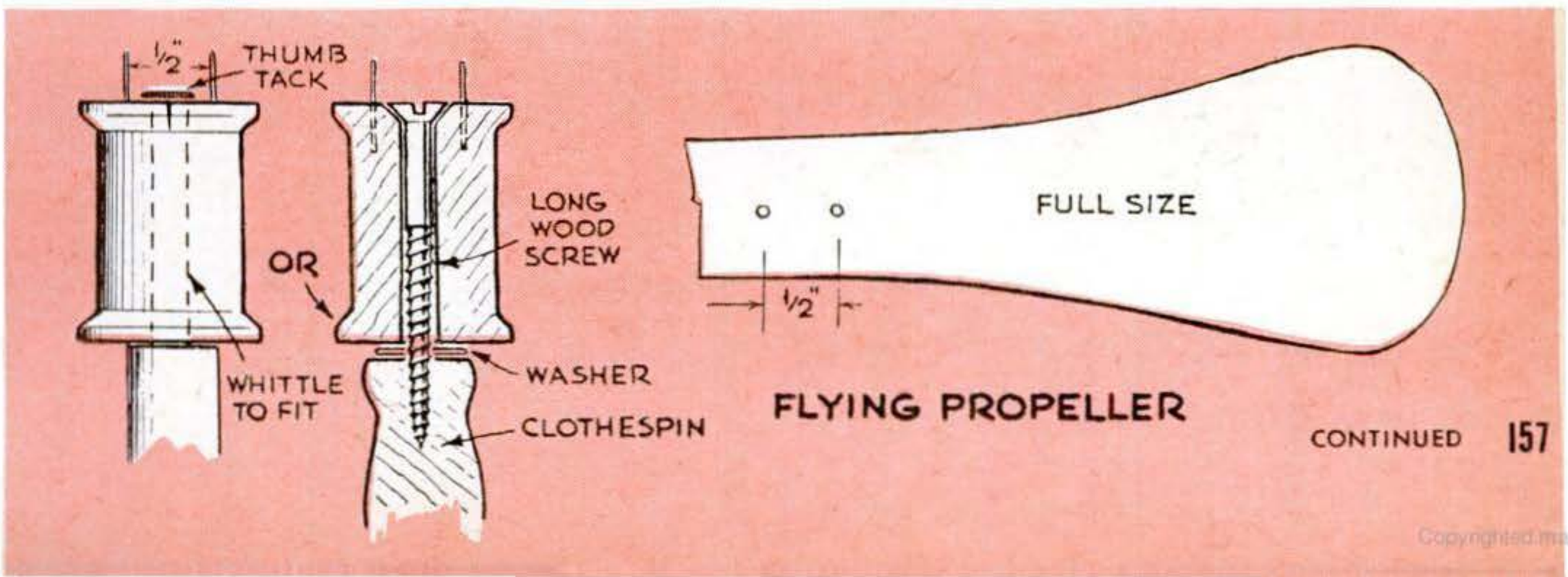


PARACHUTE

PINWHEEL



BUZZ WHEEL



FLYING PROPELLER

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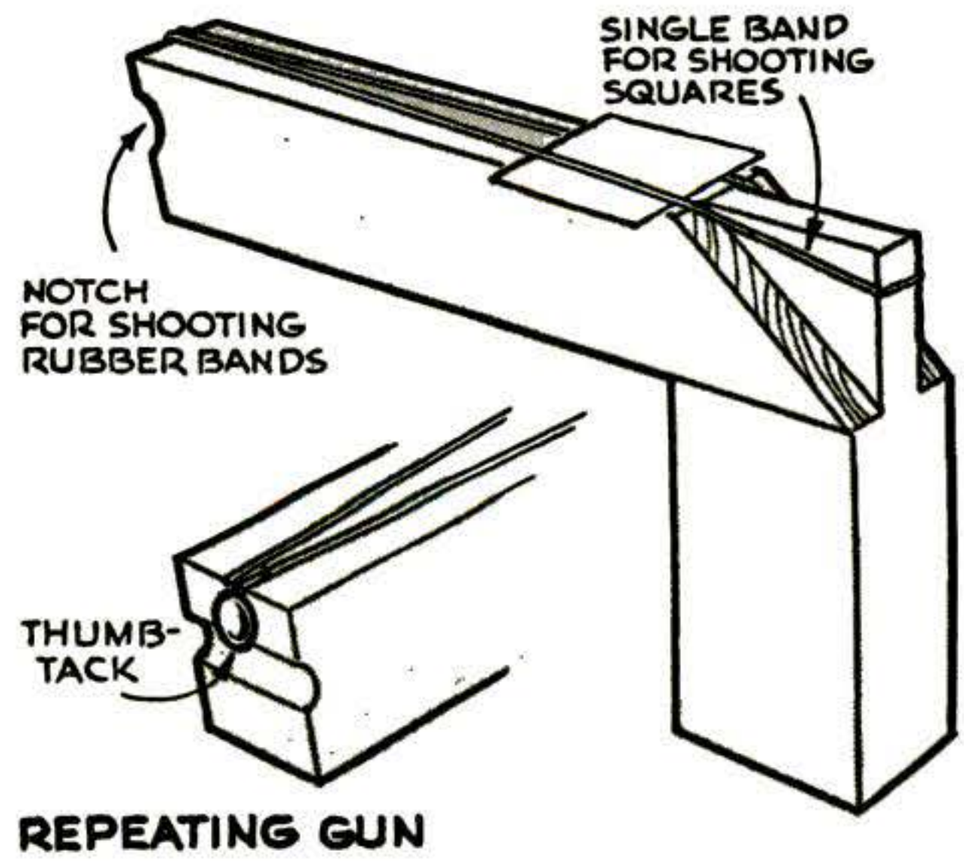
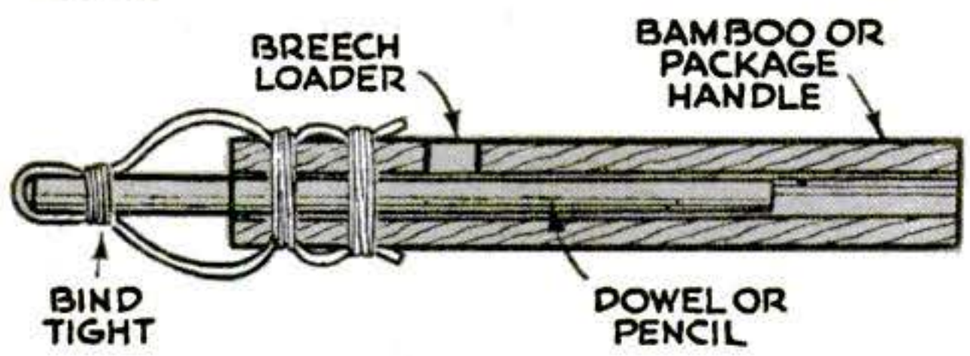
Guns Were Around Before TV

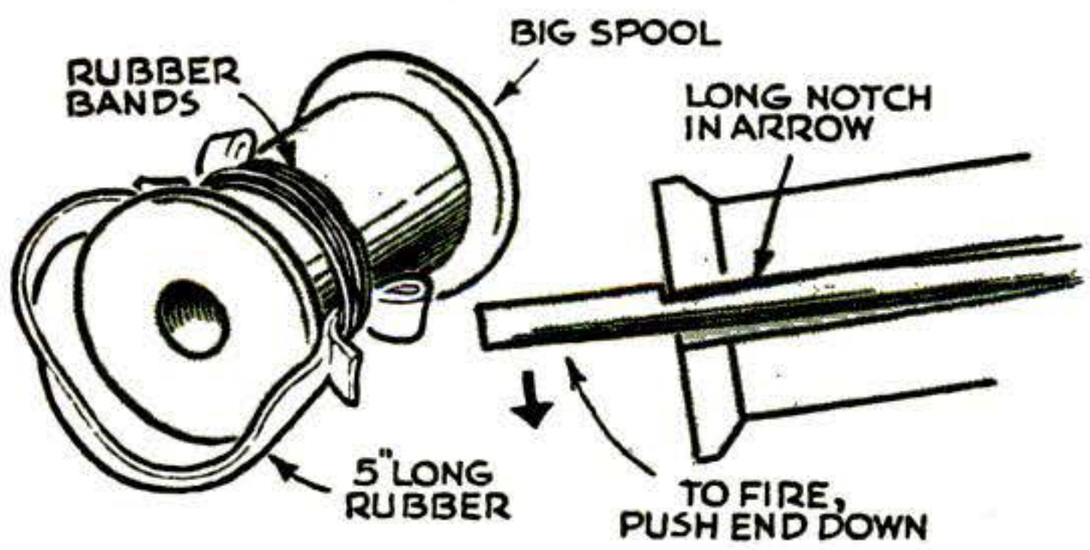
RUBBER-BAND GUNS were made from a box with interlaced corner (finger) joints, cut so that a center and two outside parts remained. Latter were sawed off at angle, leaving a sharp middle corner. Up to six bands were stretched from the front notch down on the breech, fired one at a time by rubbing up with a thumb. Single band on gun shot cardboard squares slipped in at the top.



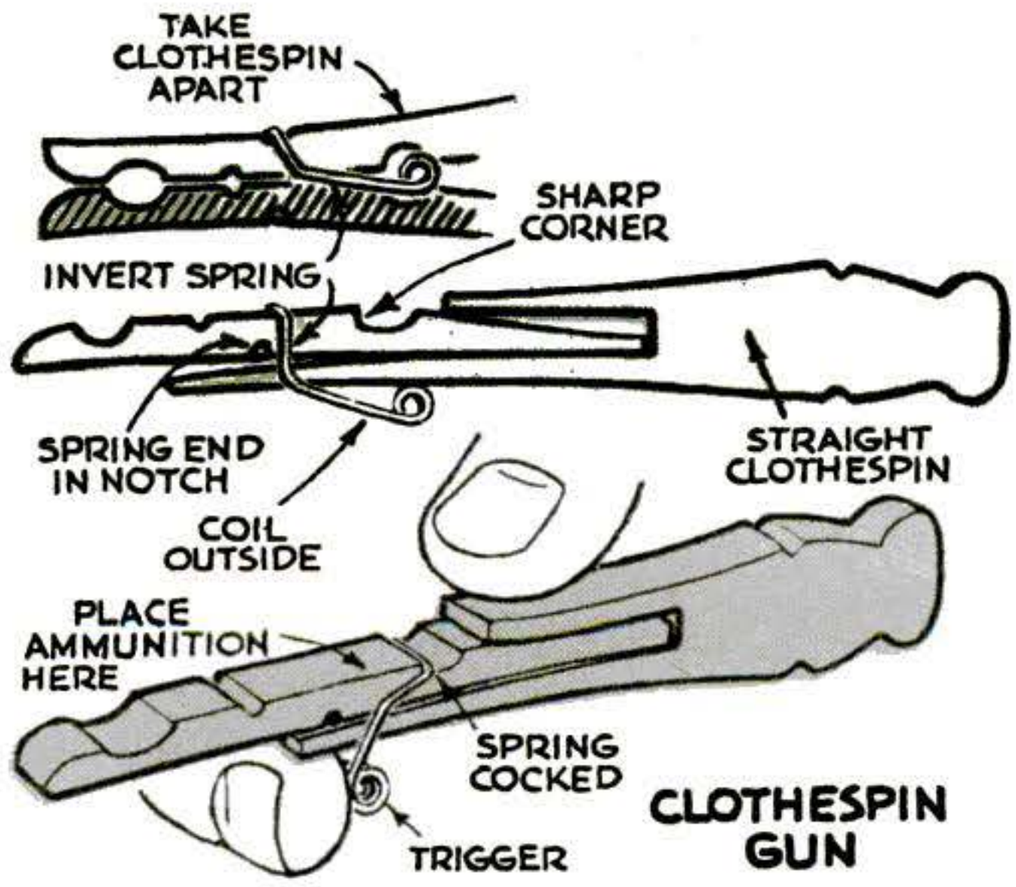
REPEATING GUN



SPOOL AND BAMBOO GUNS



BARREL-TYPE GUNS were made of bamboo, cane, package handles, or spools. The kind on top, above, were breech-loading for peas or BB pellets. The spool gun below it shot a wooden bolt, which could be notched to catch on the spool and fired by pushing it down slightly. Thin pencils, lollipop sticks, and butcher's skewers also served as ammunition.



CLOTHESPIN GUN

A HUMDINGER FOR INGENUITY, this one was made from one spring and one straight clothespin. With the spring upside down on one leg, as above, you whittled a sharp corner in the notch where the coil formerly lay. The top spring end was pushed into this notch with the spare clothespin leg (it was too hard on fingers). The gun shot with more force than accuracy.

Country boys used willow or elder branches to make whistles, pushing out the wood or the pith to leave a hollow tube. In the city, if bamboo was scarce, we used wooden package handles, which already had a good hole through them.

Wicked little needle darts were lots of fun. They'd stick in curtains, woodwork, furniture, and almost anything else, and were dangerous indeed if thrown at people or pets.

To make them, you pushed a needle, eye end first, into a wooden kitchen match, slit the other end, and inserted a little paper oblong. Twisted propeller fashion, this made the dart spin when you tossed it. It was as much fun to see it fly as to hit a target.

Rubber bands served as harmless bul-

Is your favorite missing from this collection of American folk toys? Then sit down and write us a letter about it right now. Give us a short description of the toy, what it did, how it was made, and of what. Add a rough pencil sketch if it will help explain how the toy is made. Address letters to Folk Toy Editor, Popular Science, 355 Lexington Ave., New York 17, N. Y.

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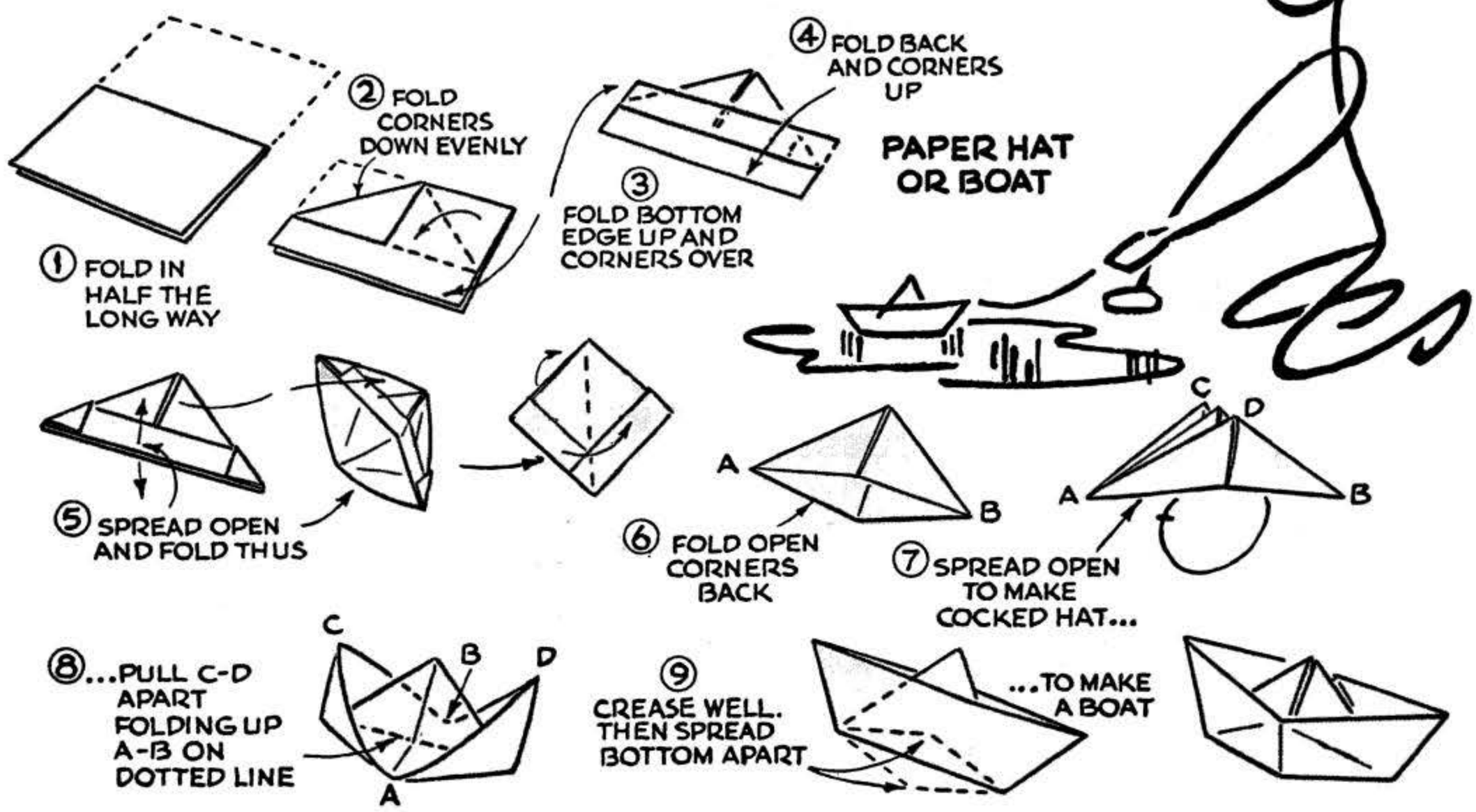
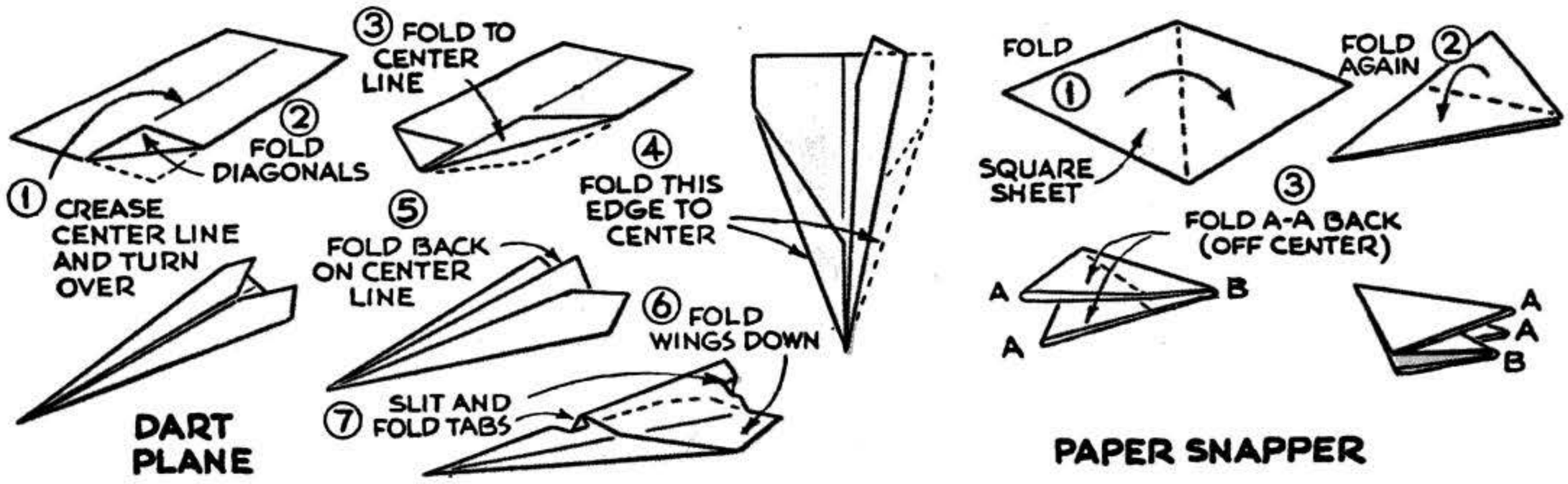
Folding Turned Paper into Fun



PAPER HAT OR BOAT? Once we learned how to fold one, we never forgot it, complex as it looks here. Newspaper was just right for folding a boy-sized hat, but too weak for boats that big. If made of good paper, boats sailed several minutes before getting waterlogged.



GLIDERS WERE SURE FUN. You folded a sheet like this without even marking it. A glue dab or folded tabs held it. If glide was too steep, you rubbed upcurves into rear wingtips.

NOISY ENOUGH TO SATISFY, snappers were best folded from fairly stiff paper. Letter sheets would do for little ones, but big ones of hard wrapping paper made a much scarier bang.

lets. One version of the rubber-band gun was very simple. A one-legged straight clothespin was held on the end of a straight piece of wood, about 2″ by 8″, by a strong rubber band. (You could slice dozens off an inner tube). A nail was driven trigger fashion in front of the inverted clothespin.

A smaller rubber band was stretched from the front to the breech end and slipped under the clothespin. Forefinger around the nail, you triggered the clothespin to fire it.

Maybe you remember the sling arrow, made from a shingle with the thick end at the head, the finlike tail being cut from the thin end. A single strong rubber band on a stick handle would send this sky-high. You had to whip the slingshot out of the way of the arrow just as you let go. Gliders would be sent way up with these same single-stick slingshots.

We made crude wind-up toys with rubber-band motors, pitted them against one another in races, hill climbs, or head-on pushing matches. Big thread spools were best for rough going—you could notch

[Continued on page 218]

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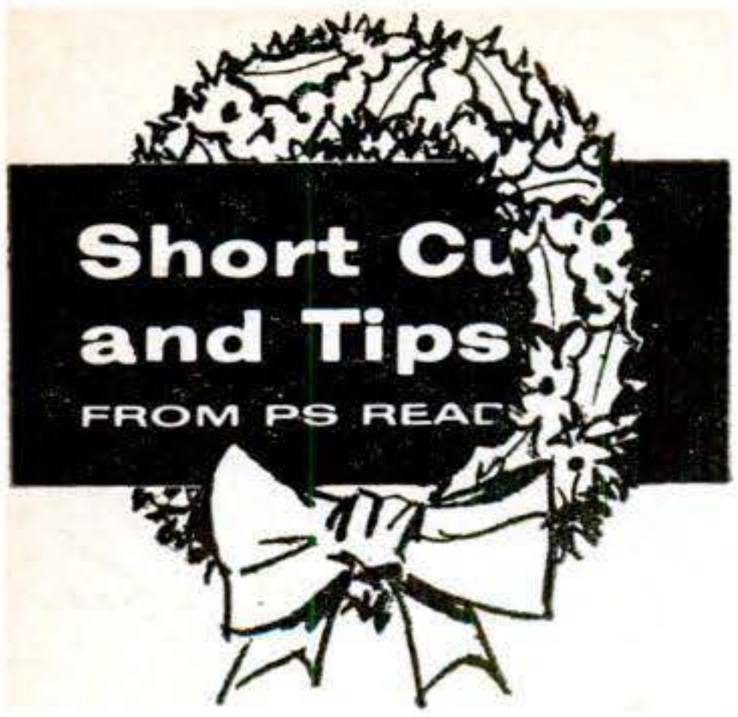
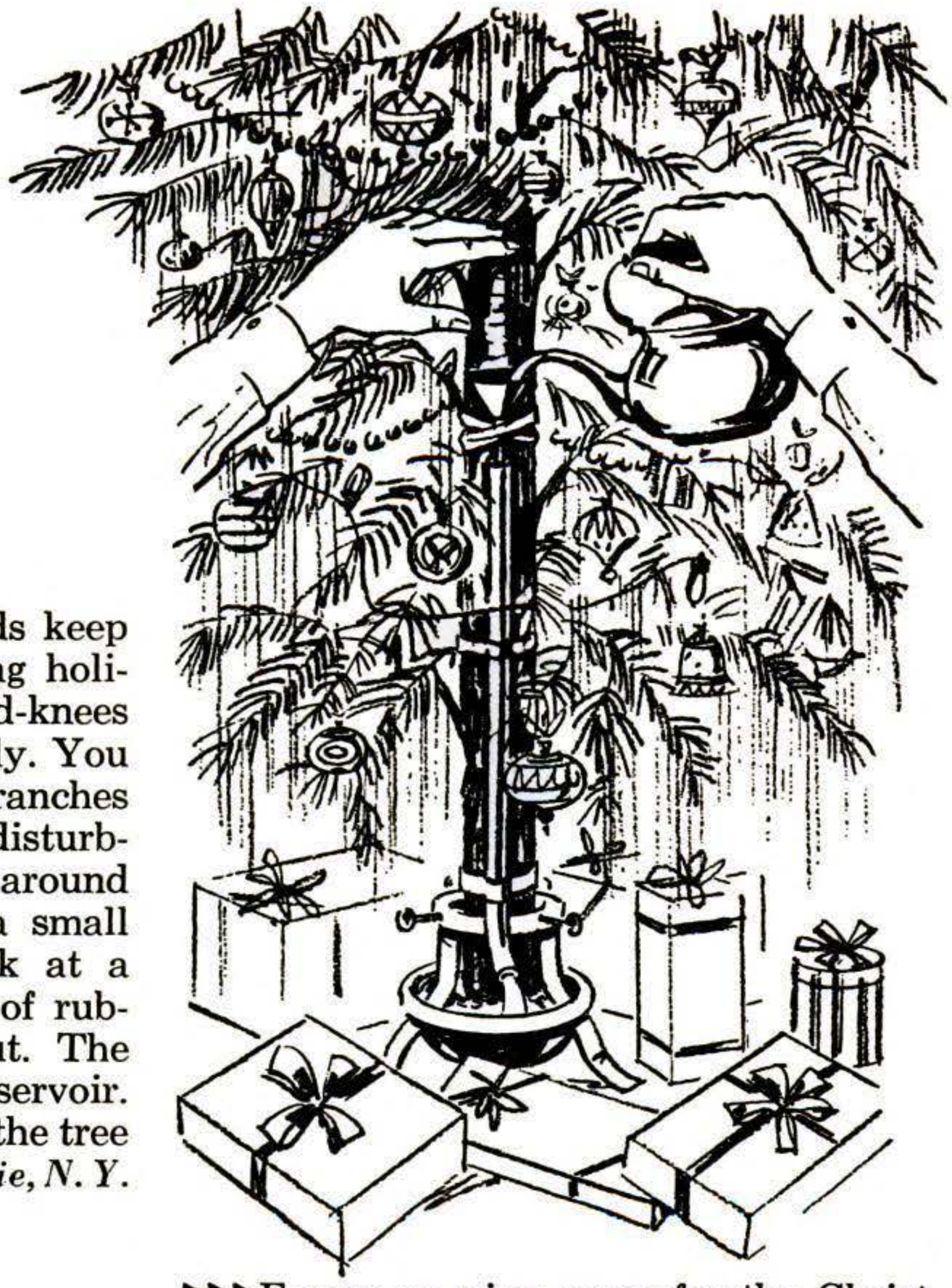
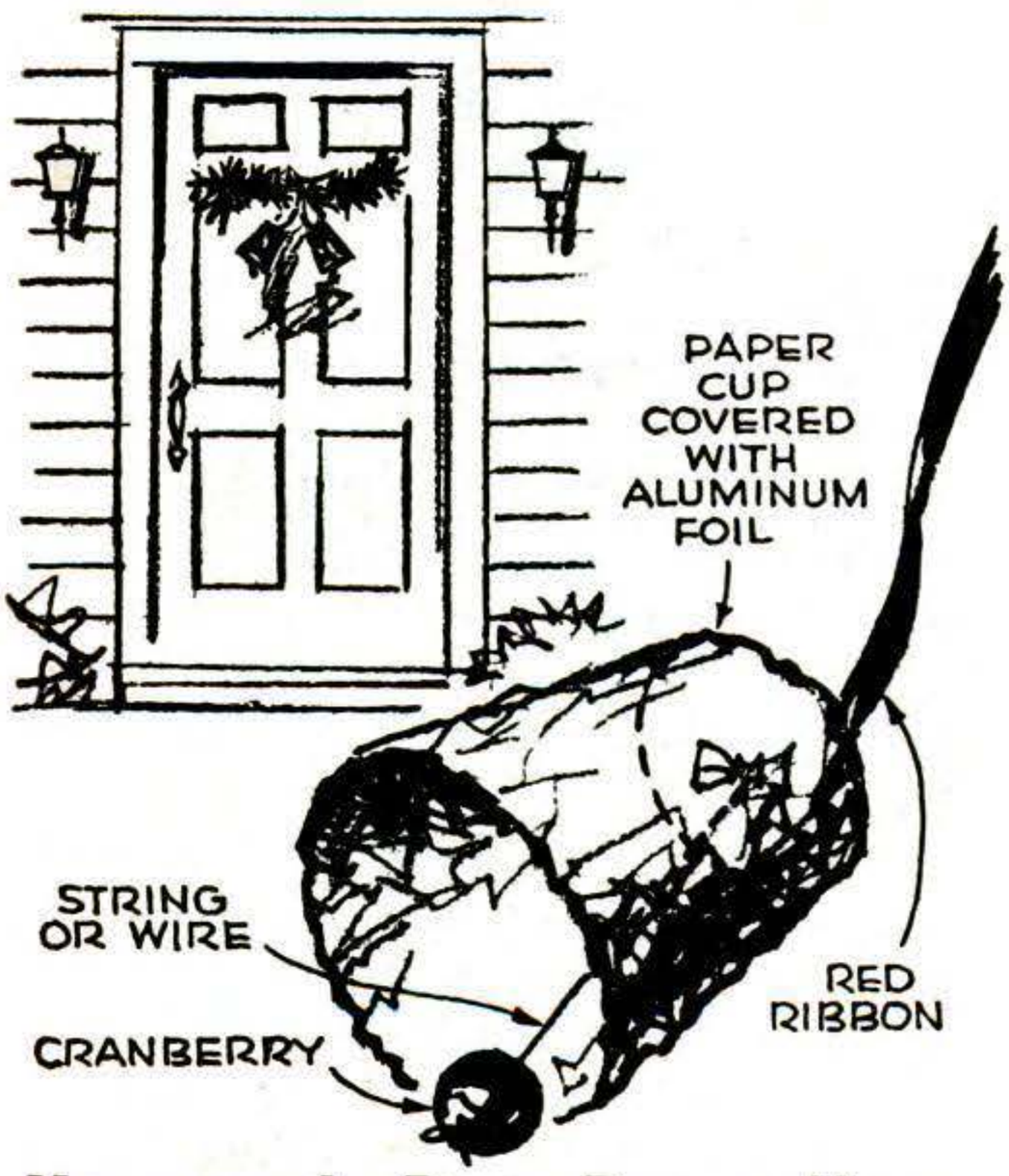


Watering the Yule Tree

RESERVOIR Christmas-tree stands keep the needles fresh through the long holiday season, but it's a hands-and-knees chore to replenish the water supply. You have to duck in under the longest branches—usually pulling off tinsel and disturbing the arrangement of packages around the tree. Avoid this by taping a small funnel to the back of the trunk at a convenient height. Slip a length of rubber tubing onto the funnel spout. The tube's other end drains into the reservoir. The funnel won't be noticed when the tree is trimmed.—*A. Tanner, Poughkeepsie, N. Y.*

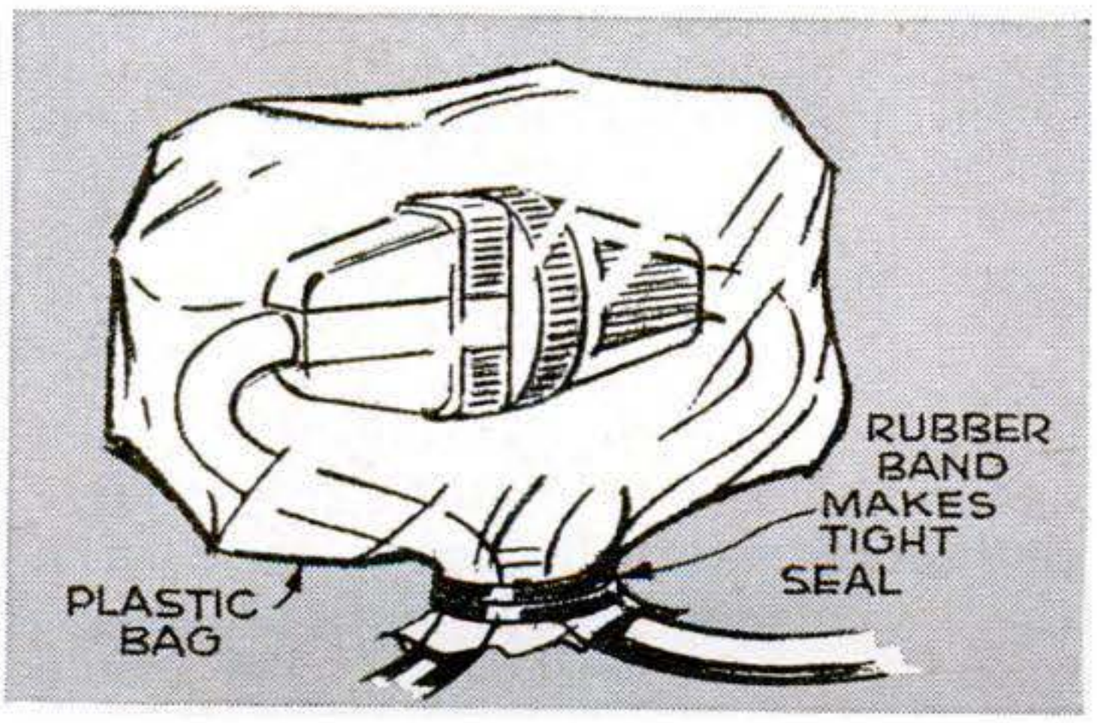


▶▶▶FANCY up pine cones for the Christmas season by touching the tips with gilt or silver. This can be paint or glued-on glitter. Then, to preserve both the color and the cone itself, spray all over with shellac from an aerosol can.



Homemade Door Decoration

GREET your holiday guests with this attractive but inexpensive decoration for the front door. Mold crinkled aluminum foil around sturdy paper cups, add cranberry clappers, and hang the bells from an evergreen sprig with weatherproof ribbon.—*William B. Eagan, Maceo, Ky.*



Weatherproof Outdoor Wiring

WINTER is a rugged time to run extension cords outdoors. To make sure your display lighting doesn't short out on Christmas Eve, keep each exposed socket connection dry by slipping on a plastic bag and sealing it around the wires with elastic.—*R. A. Dietsch, Middlesex, N. J.*

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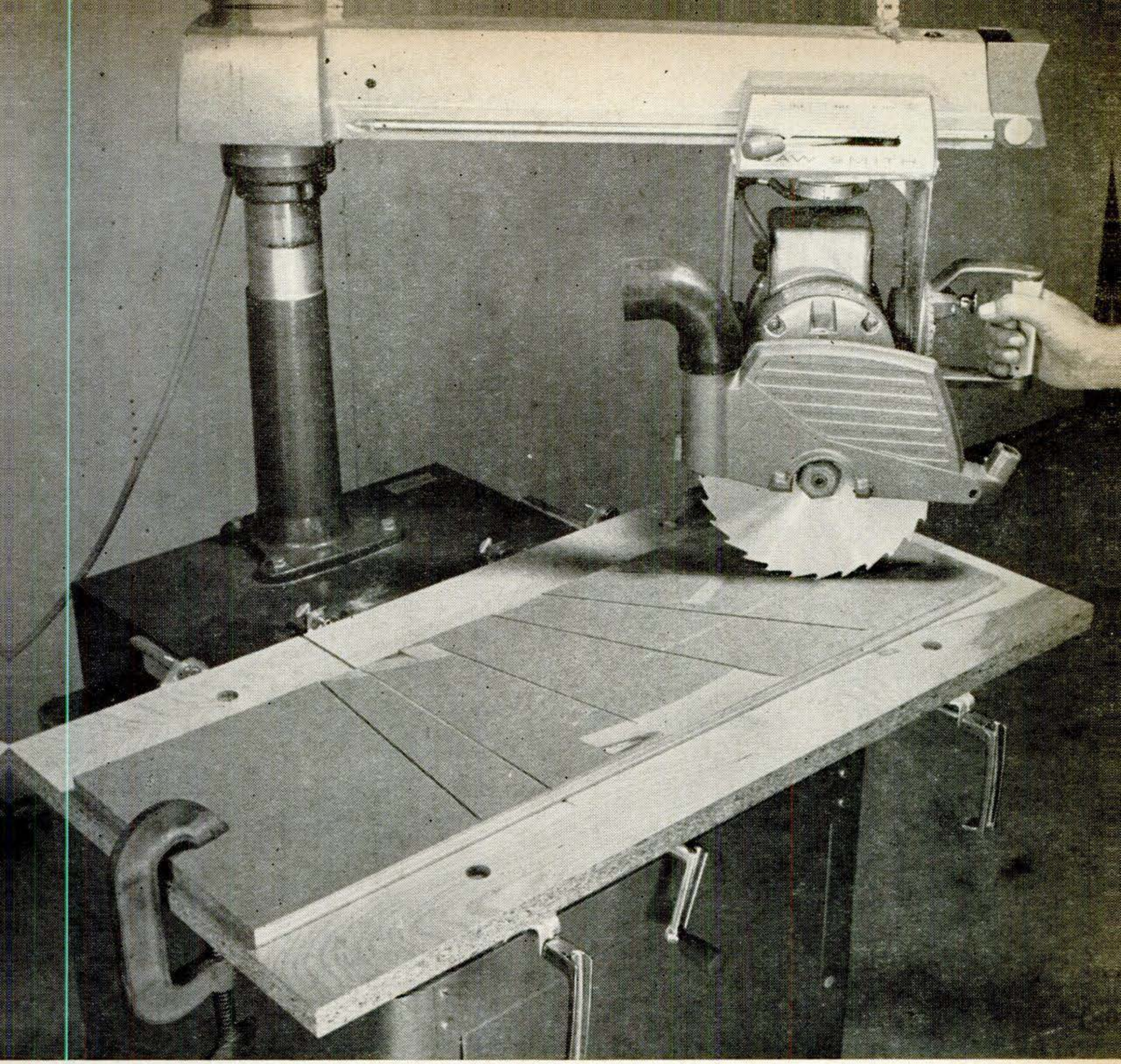

SAW TABLE MUST BE PARALLEL to the arm at all points. To check, clamp a good-size piece of plywood to the table (be sure it lies flat on the table at all points) and set saw height to make a slight scratching cut near the center. Swing the arm about to index points and move the saw back and forth on the arm. All the cuts should be of uniform depth.

Getting the Best Out of a Radial Saw

By R. J. De Cristoforo

SETTING up a radial-arm saw to make the most of its accuracy and versatility doesn't take long. Some basic alignment checks, plus a few simple jigs, will let you take full advantage of the magic of the machine.

Minor misalignments will probably never be noticed as long as you're building only rough hammer-and-nails projects. But when you try fine cabinetwork

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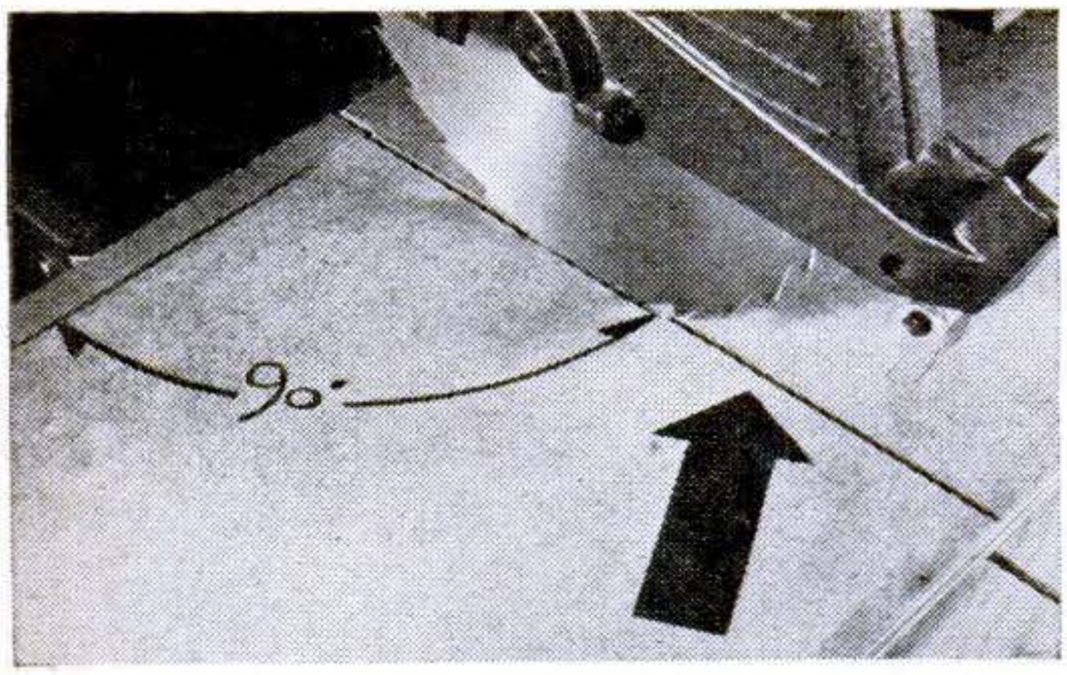
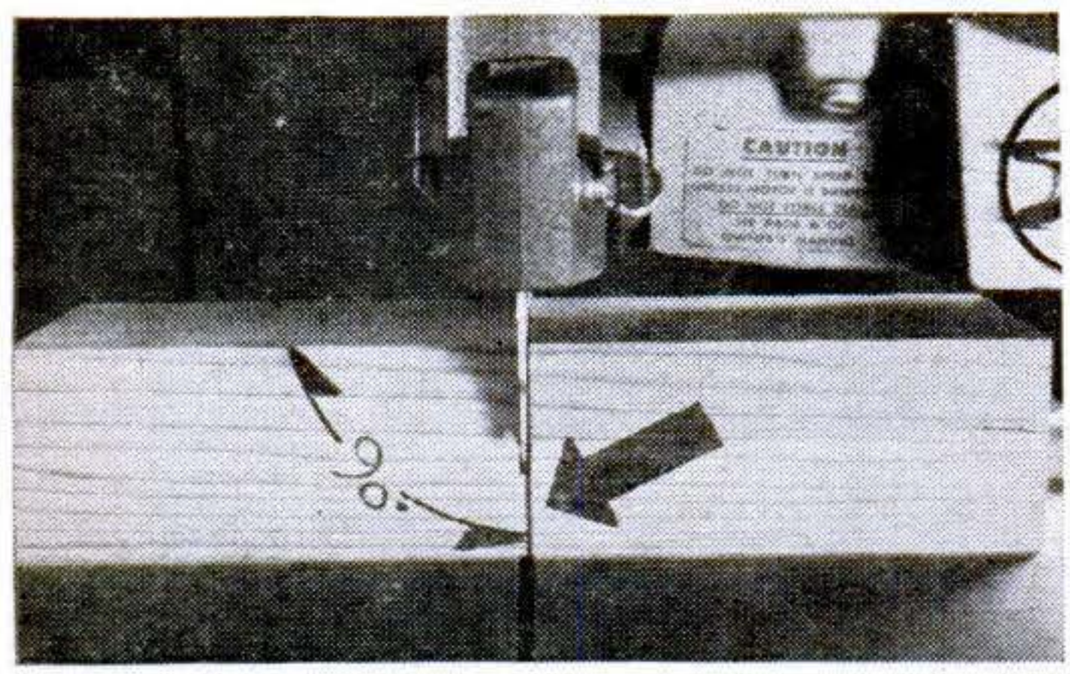
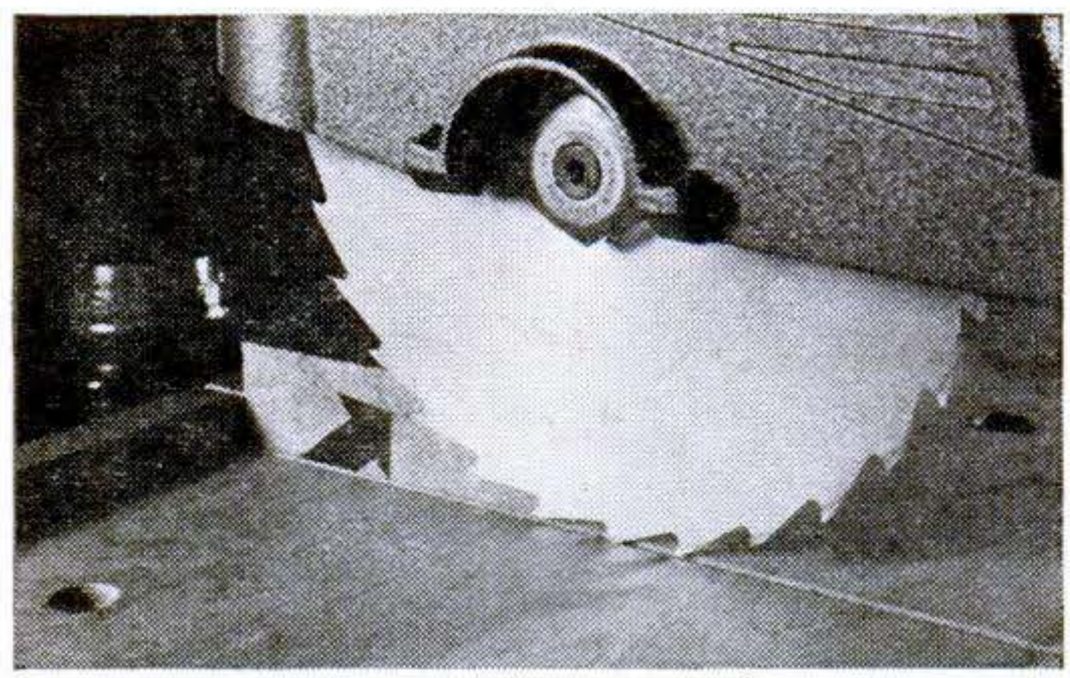
Basic alignment checks



ACCEPT ONLY A PERFECT CROSSCUT: Check with a board as wide as the maximum crosscut capacity. True one edge and use a framing square to mark a cut line. Place true edge against fence and cut the edge of the line. Leave enough of the line so you can detect any deviation of the cut. If adjustment is needed, your owner's manual will tell you how to do it accurately.

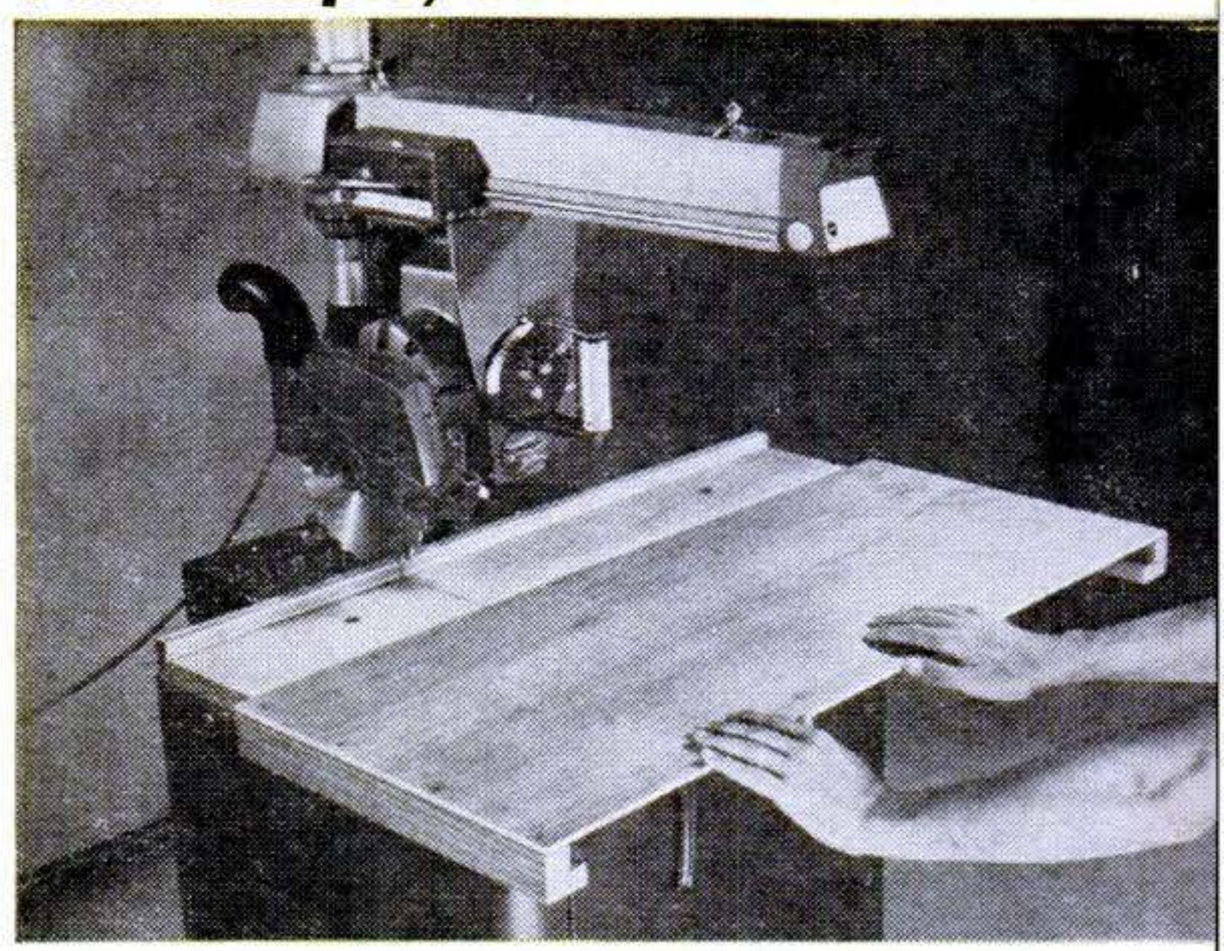


VERTICAL PLANE OF THE CUT must be at right angles to the work surface. Use a surfaced piece of stock thick enough to require the maximum depth of cut. With the square, draw a line across the top surface and down the adjacent edge. Be sure the lines meet precisely at the corner. Cut the edge of the line, leaving just enough of it to detect any error.

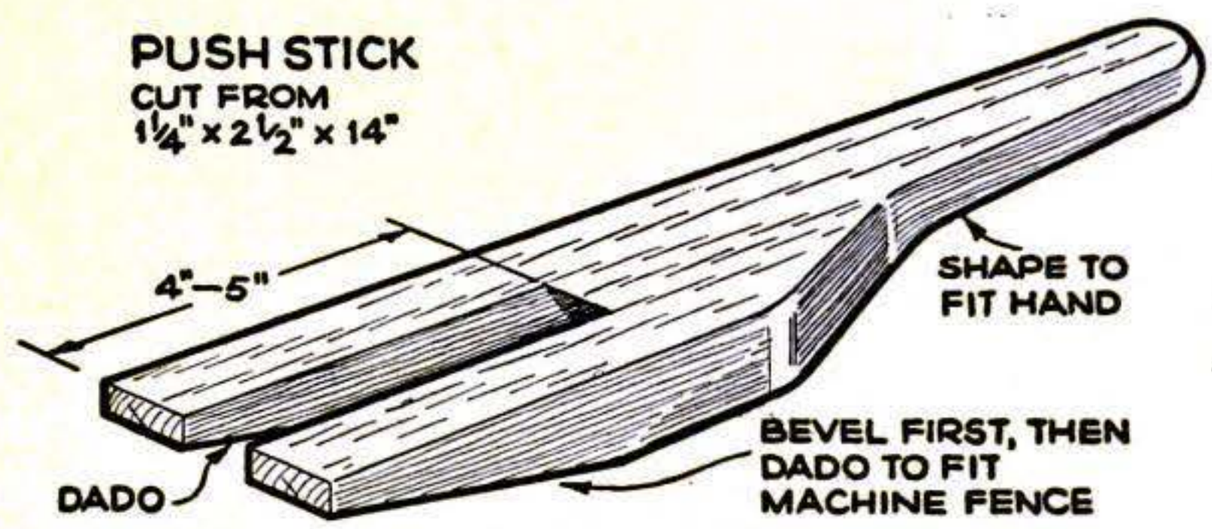


TO AVOID ROUGH CUTS, wide kerfs, and splintering on plywood, the plane of the blade must be parallel to the arm. "Heeling" results if the leading teeth and trailing teeth cut in different planes. To check, stop the blade before it leaves the cut and look for circular marks (arrow). If marks appear on the wood, the trailing edge of the blade must be shifted to the left.

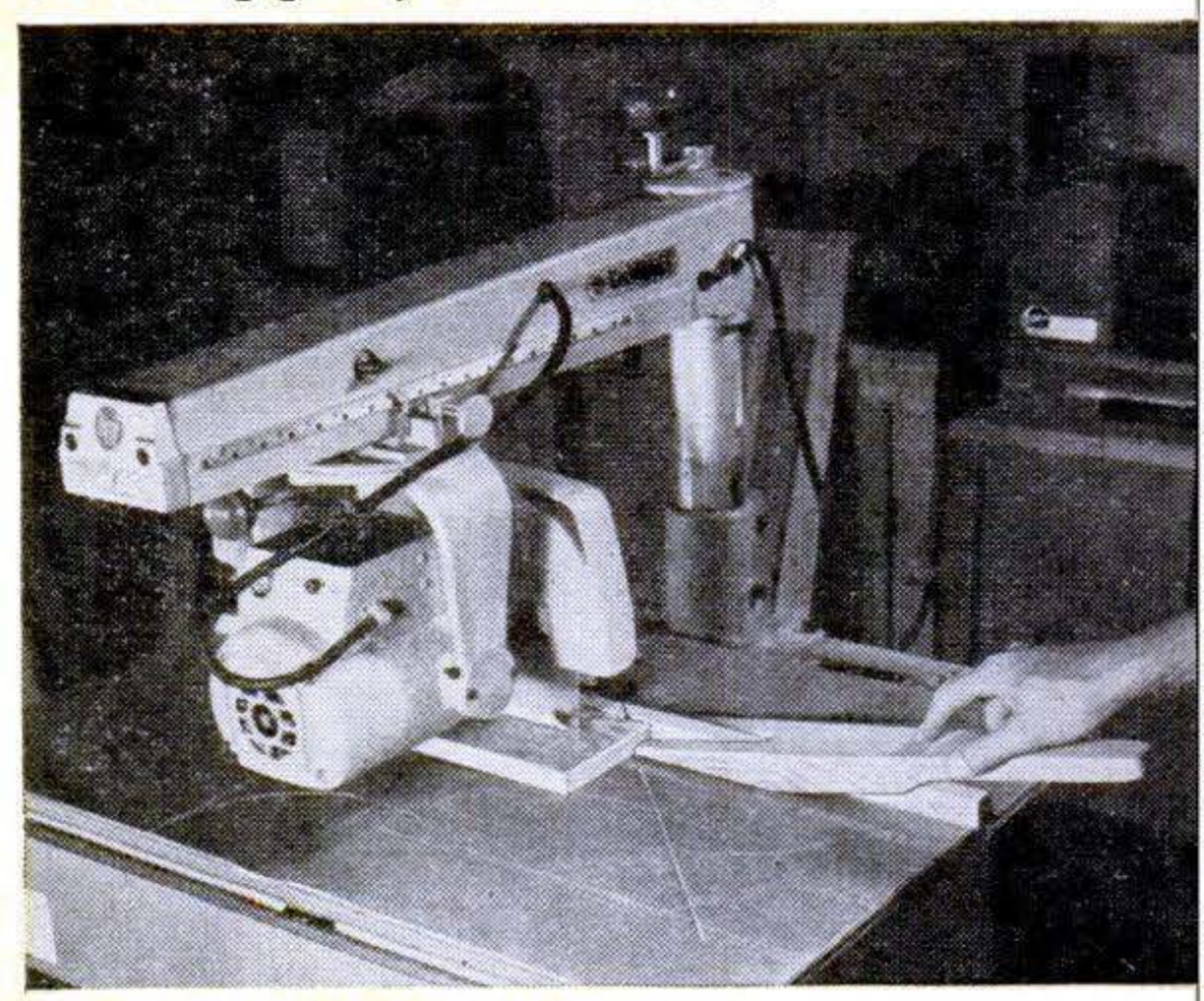
Four simple, useful accessories



AN AUXILIARY TABLE that slips on or off easily will help preserve your new saw table. Use it for cutting off when the blade is pulled through the work. Save the original surface for jobs requiring the workpiece to be moved past the blade.



PROPERLY DESIGNED PUSH STICK is as useful as a third hand. Not only will it help you keep all your fingers, but you'll get smoother, faster, and more accurate rip cuts. Make it long and shaped to straddle the cutting guide, as shown below.



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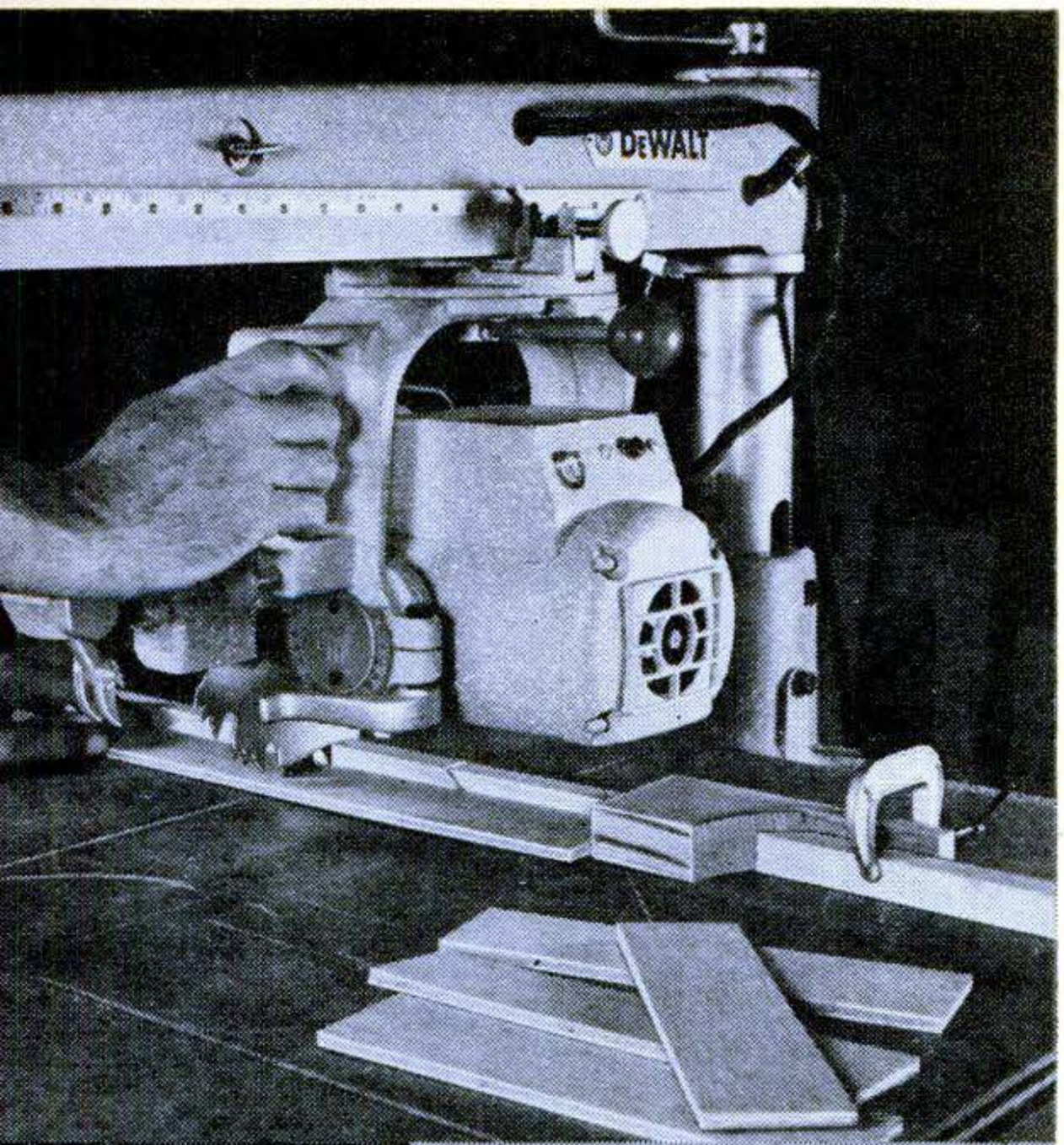
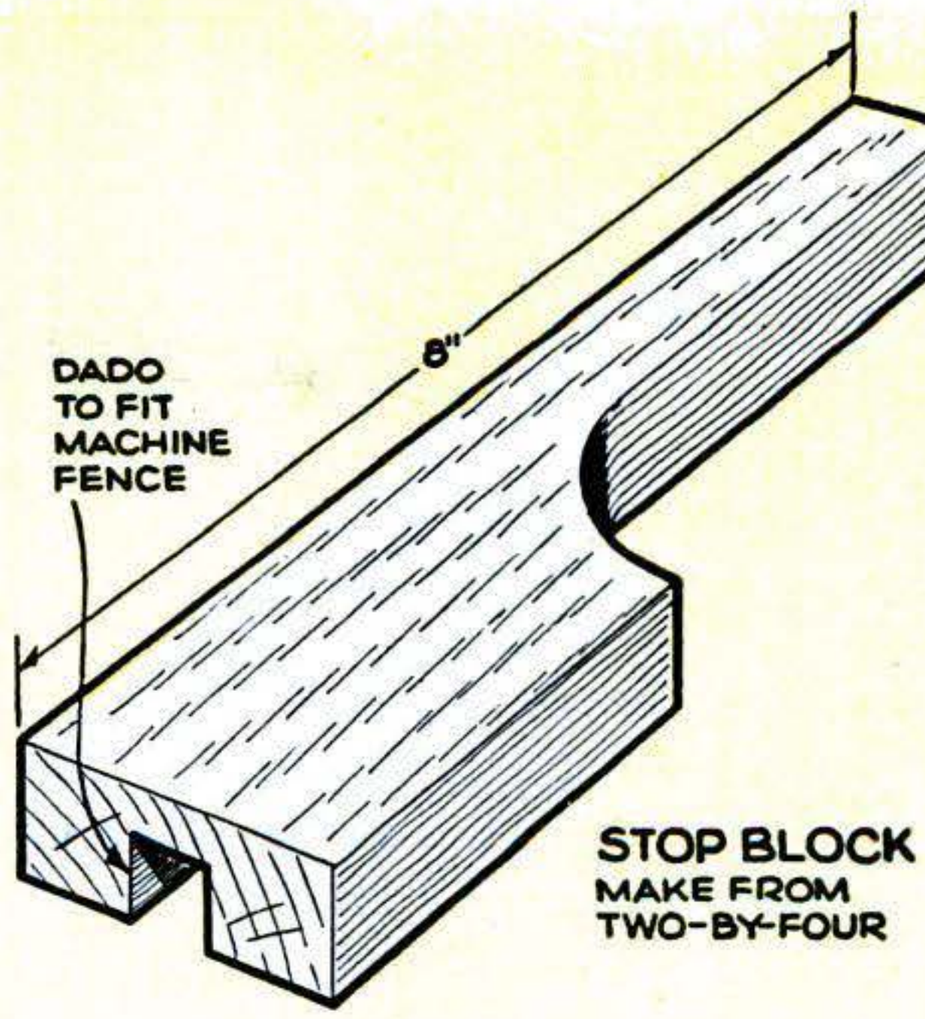
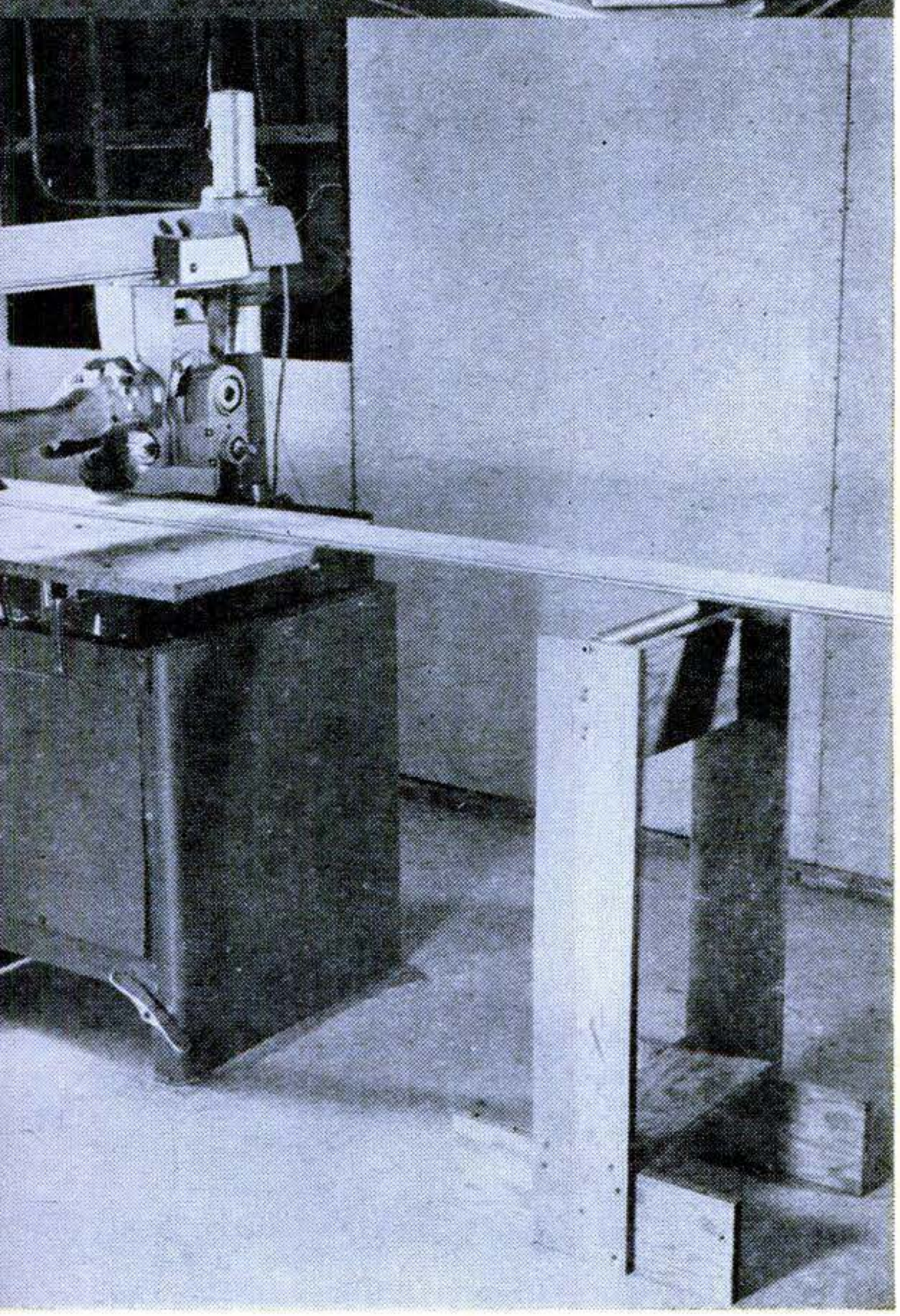
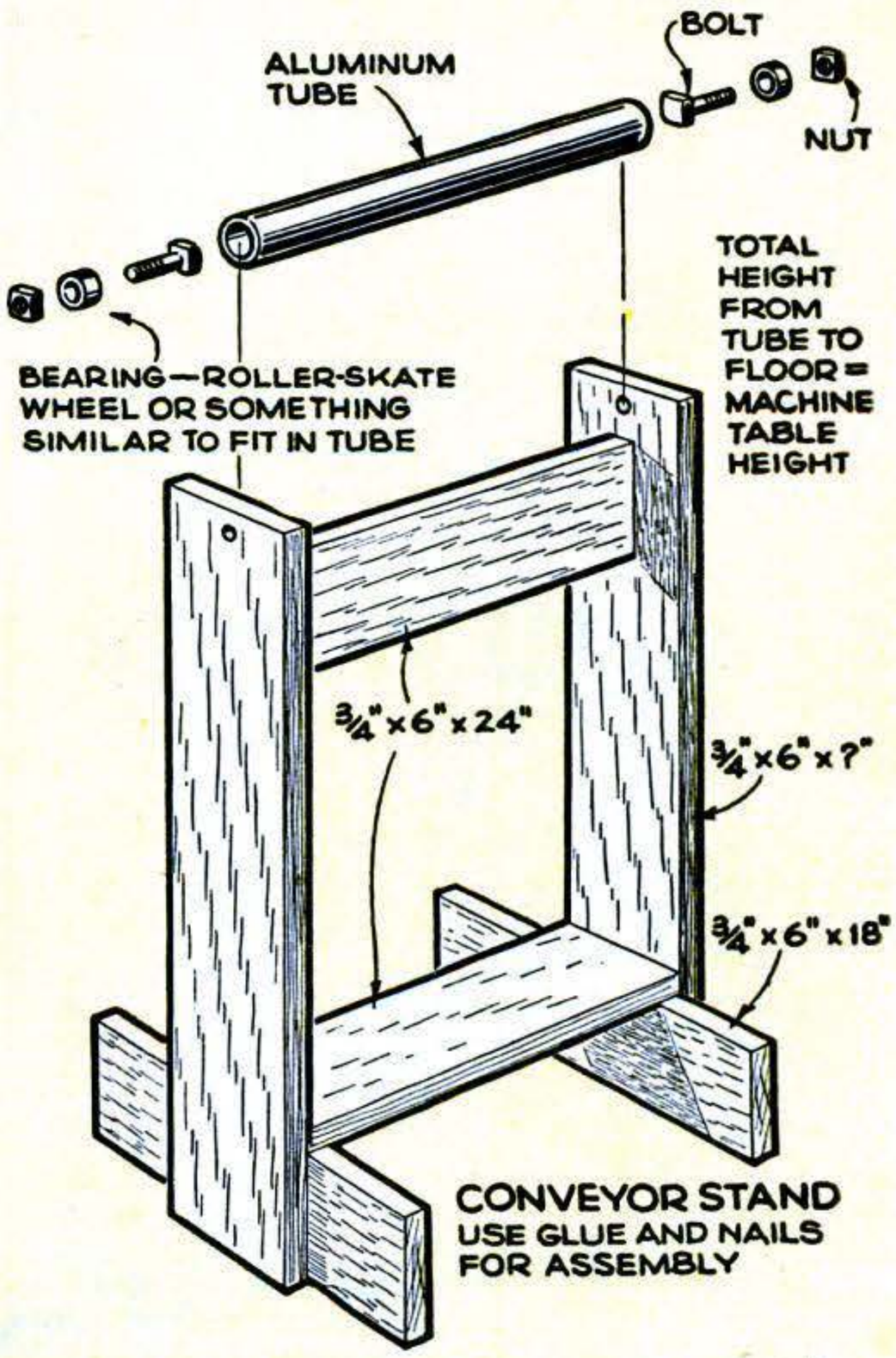
you should make





PERMANENT STOP BLOCK will increase speed and accuracy when you make duplicate parts. This one straddles the cutting guide and is fastened with a C clamp (photo at left). Saddle design makes it easy to adjust and clamp with one hand.





WORK SUPPORTS ARE A MUST if you wish to make the most of a radial saw's potential. If you don't want permanent structures, make portable supports that can be used at either side for long pieces (as at left) or in front for ripping panels.

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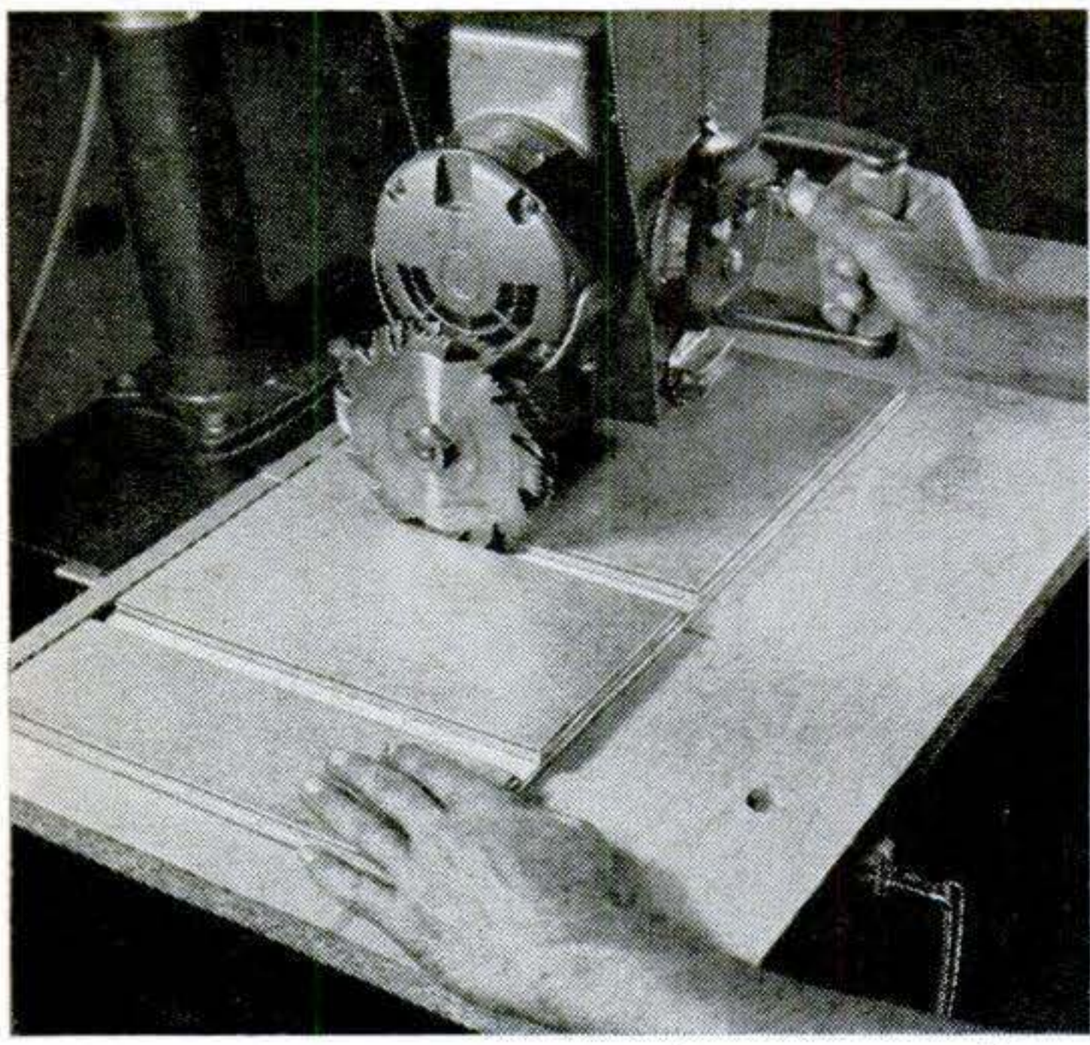
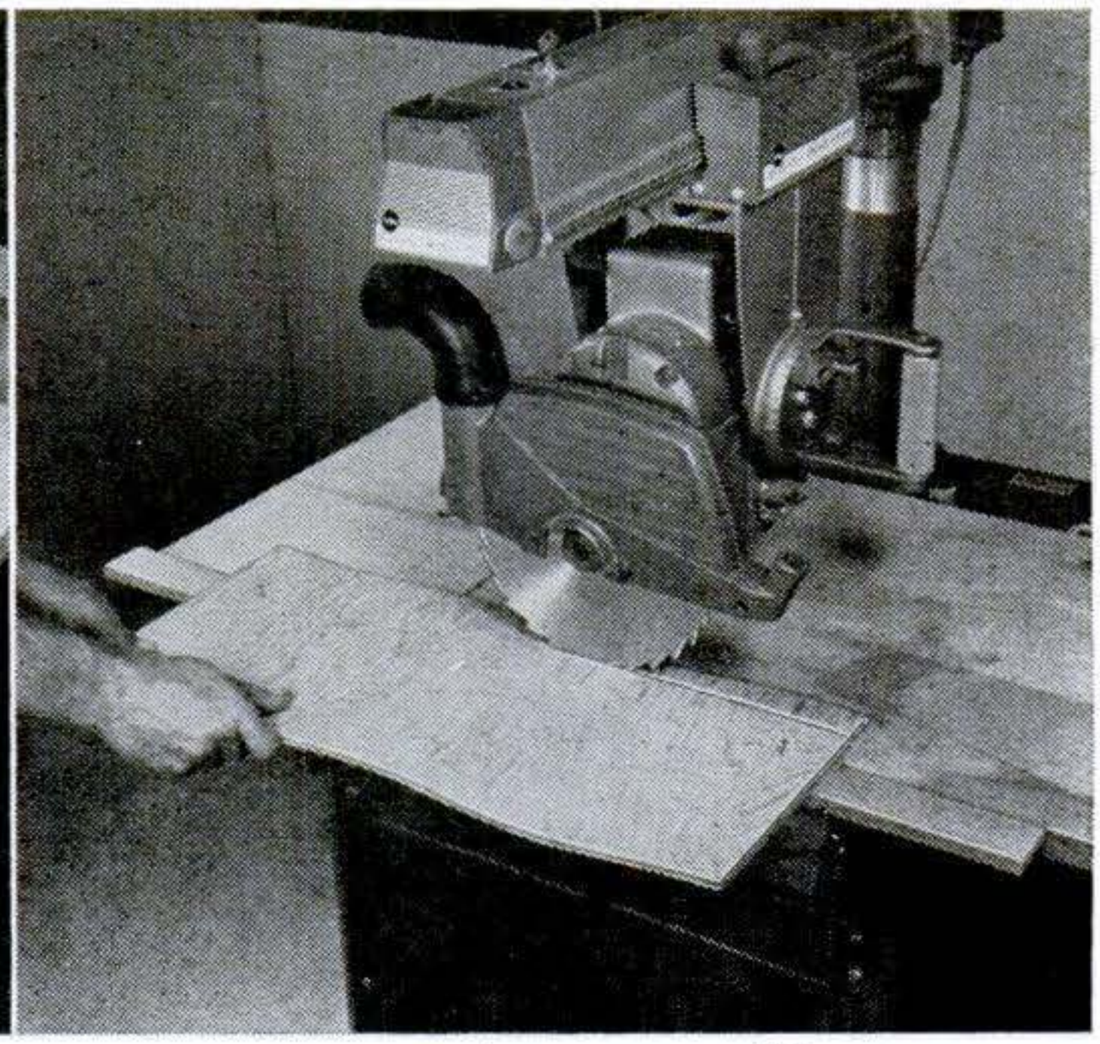
or furniture, they can make the difference between wood butchery and real craftsmanship. Excessive splintering, irregular dadoes, rough edges, off-square crosscuts, and miter cuts that don't quite mate are a few of the troubles that often get blamed on the machine. All first-class radial saws have built-in accuracy—and the adjustments for maintaining it—that will avoid these troubles. It's up to you to get all the value you bought. Also, just because the tool is brand-new, you cannot safely assume that all its adjustments will be right on the nose. Neither can you expect the adjustments to hold forever. It's wise to recheck them occasionally.

The illustrations and captions show the important points to check and a few simple accessories that will speed your work and improve your accuracy.

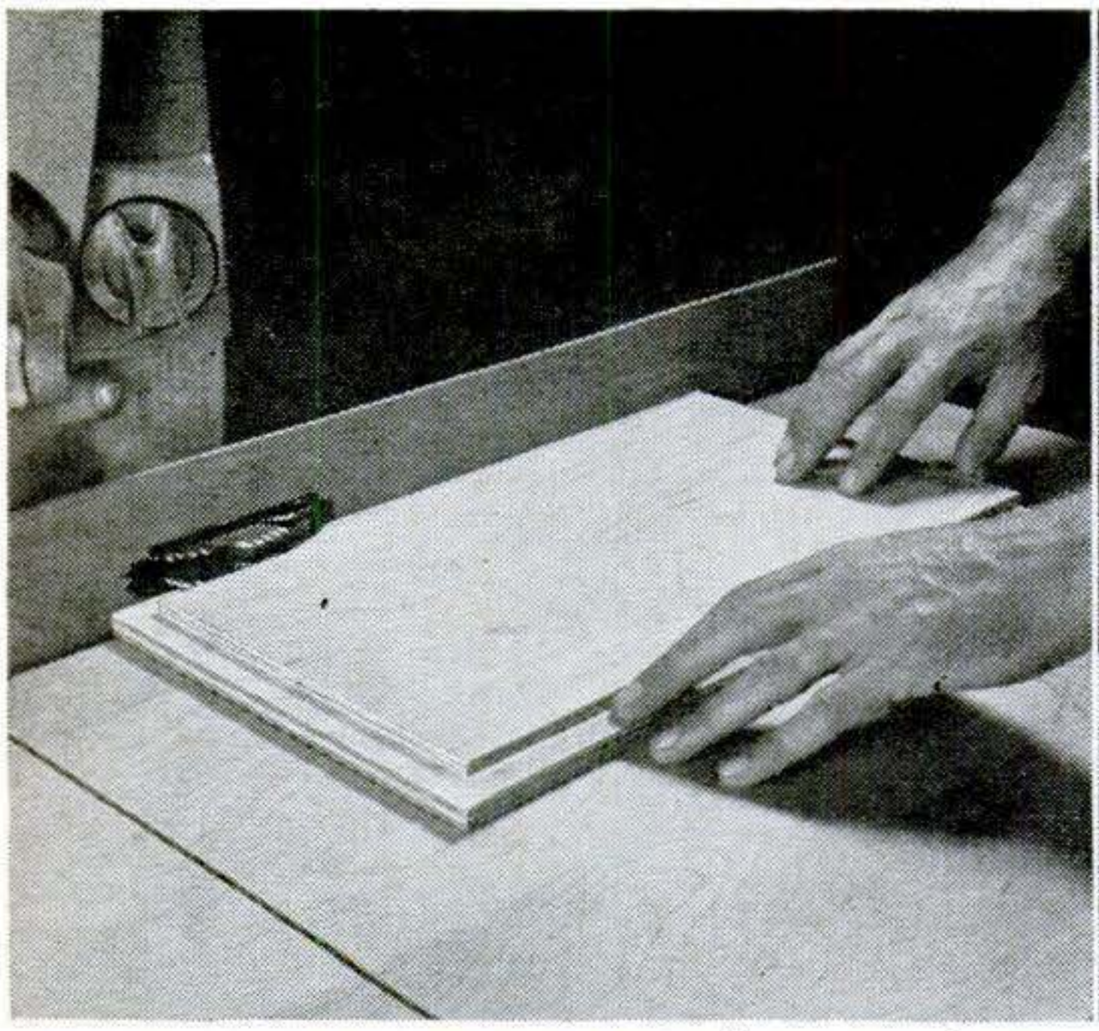
Four ways you can cope with problem cuts



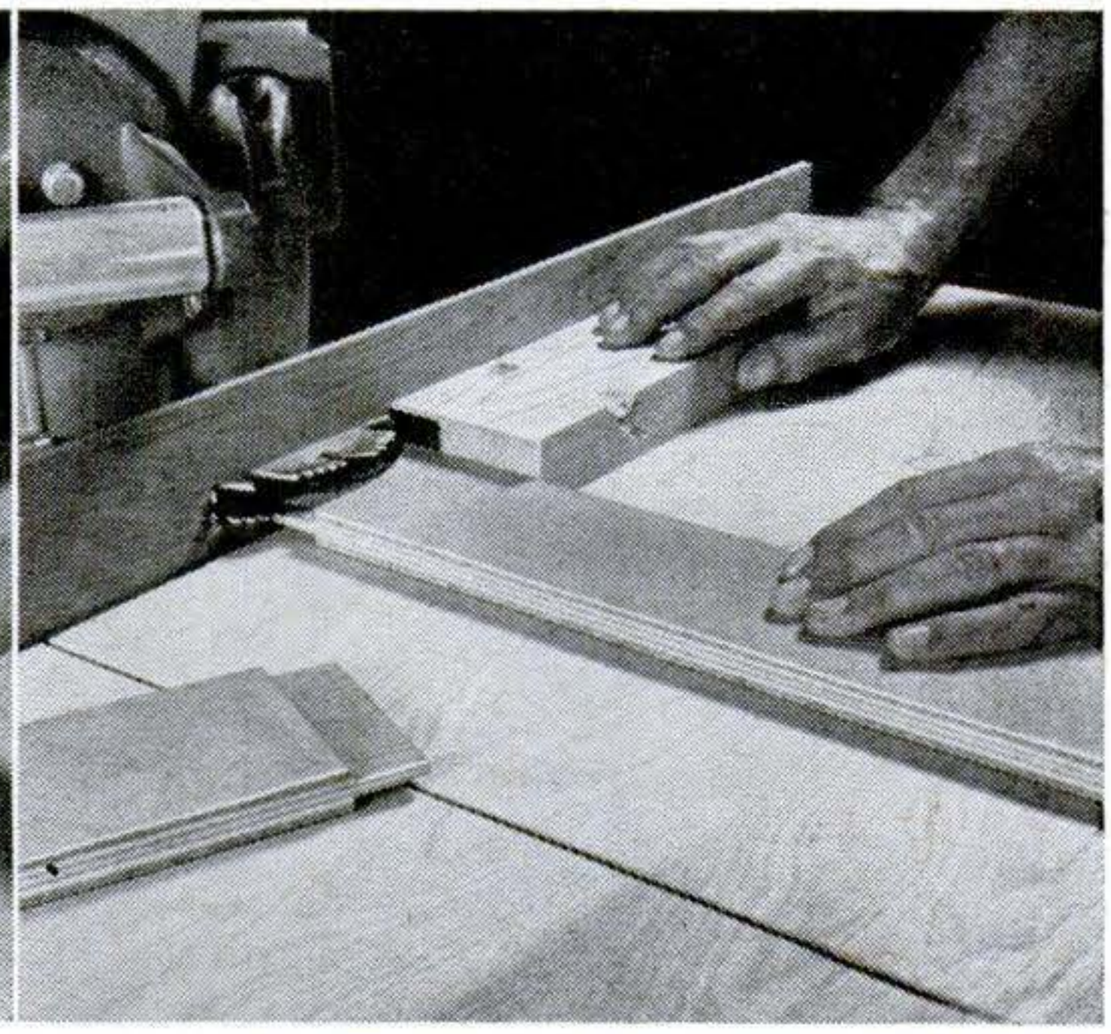
YOU'LL PULL THE SAW BLADE for most cuts, but occasionally you can do better by pushing. When much stock must be removed, this method overcomes the tool's tendency to climb. Always use a guard. It's omitted here to show the tool.



"OUT-RIPPING" makes some problem cuts easy. Clamp or tack-nail the work to a guide strip, which rides the table edge. You can cut straight edges on uneven stock, make long tapers, and cut otherwise impossible angles.



EXTRA-WIDE RABBETS are a cinch to cut if you set up the blade parallel to the table. Use an extra-high fence and cut the opening by pulling the blade through slowly. Adjust cutter position for correct depth and width of rabbet.



EDGE GROOVES, TENONS, TONGUES, and similar cuts are also best made with blade parallel to table. When work width has little bearing area, use push block to feed work. On tenon cuts, the fence opening must fit the cutter closely.

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August 9, 1960

The Editor
POPULAR SCIENCE MONTHLY
355 Lexington Avenue
New York 17, New York

Dear Sir:

Why is it that, when installing 230-volt electric appliances, the neutral wire (the white one) is not to be used? Take an electric motor, for instance. What is there about 230 volts that makes it mandatory to dispense with the neutral wire, leaving only two "live" wires attached to the motor?

I take it for granted that the appliance must be properly grounded, but that is usually done with 115-volt appliances anyway, and I did not think that the neutral wire accomplished merely this. If you disconnect the neutral wire to a 115-volt appliance, it ceases to run even though it is still grounded, whereas a 230-volt appliance runs without the neutral wire at all.

Also, if it is possible to get a shock by touching neutral wire when a 115-volt appliance is running, why cannot such a shock be obtained when touching a 230-volt appliance--if grounding does what the neutral wire does?

Also, if the appliance is portable, in which case I would ground it with a green wire, what would be the effect on the efficiency of the appliance of not having such a green wire?

Yours sincerely,

Arthur J. Grenfeld

Why Ground Electric Systems?

By Hubert Luckett

ANSWERS to the questions asked in the letter above are vital to everyone not reading this by kerosene lamp. The 1959 revision of the National Electrical Code has important new requirements for grounding household appliances and portable electric shop tools. More of the tools and appliances you'll be buying are now required to have a three-wire cord and grounding plug. Also, an increasing quantity of 230-volt equipment is being marketed for home use.

Unless you understand the 115-230-volt distribution system and how it is grounded for protection, you may cancel out your protection, or even increase the hazard, when you make changes in your wiring or replace plugs and cords. This information may prevent a fire or save a life.

To understand the ordinary three-wire system for bringing power into your home, look at Figure 1 on the next page. With two 12-volt batteries connected in series, and using only three wires, you can provide two 12-volt circuits and one 24-volt circuit. To supply 24 volts to the motor, you need just the two outside

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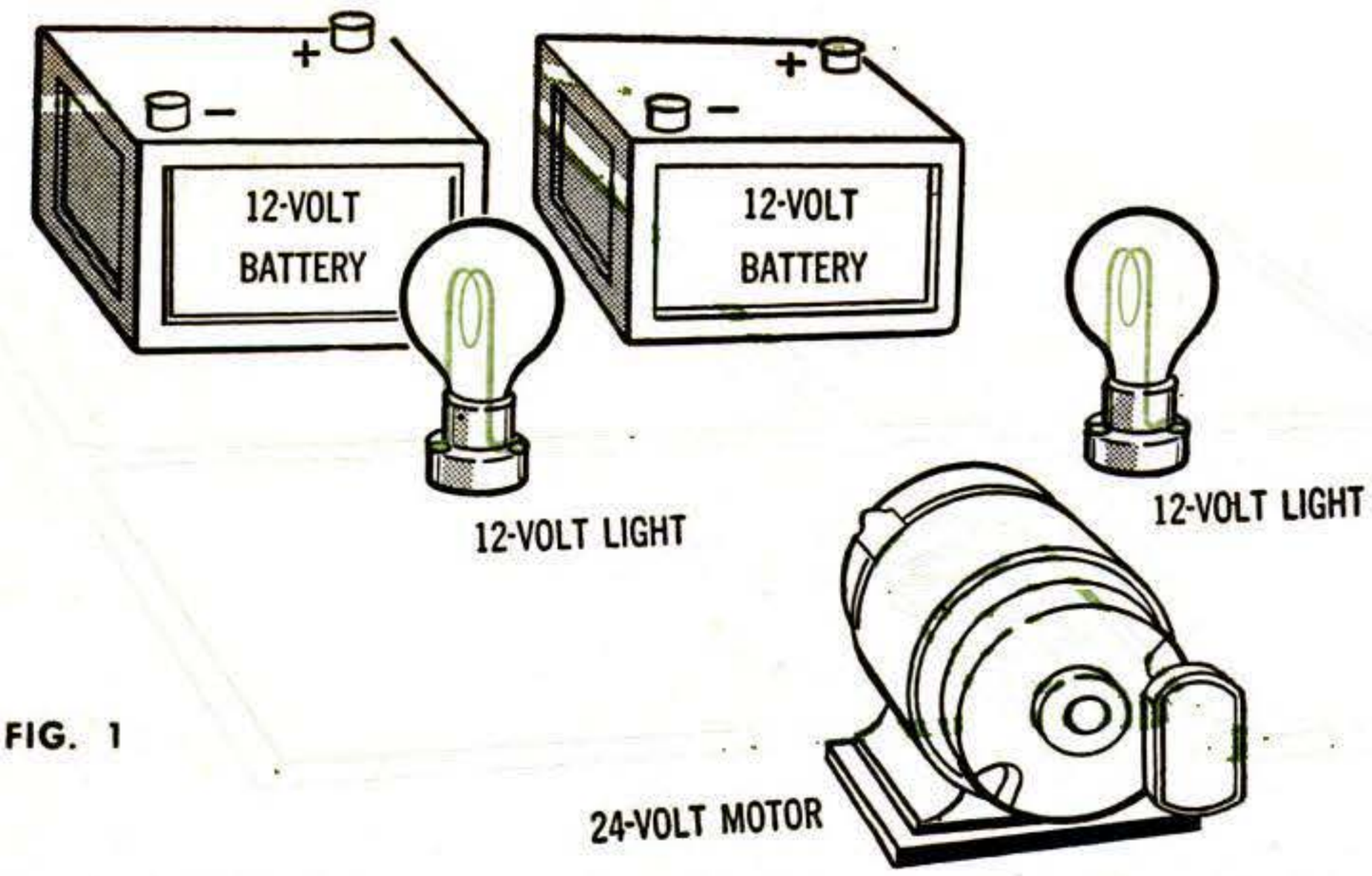

FIG. 1

wires—the middle wire is used only for the 12-volt circuits.

Substitute two 115-volt AC generators for the two batteries, and a motor connected to the two outside wires will re-

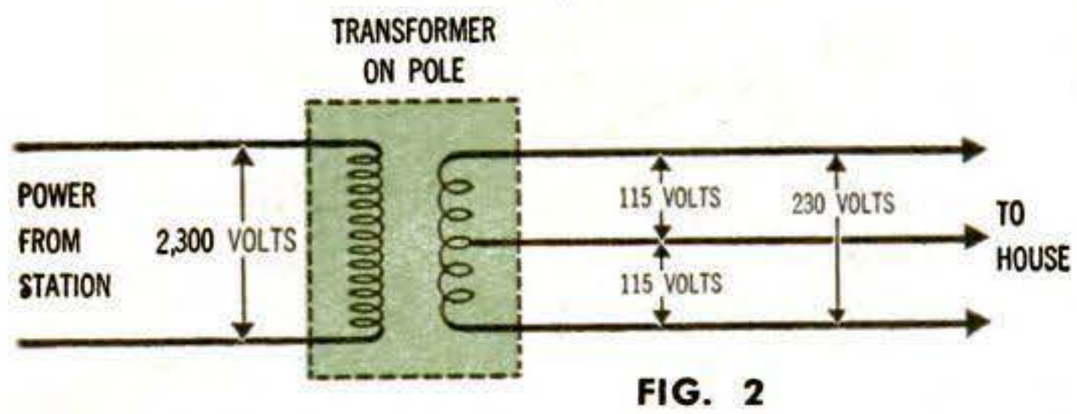

FIG. 2

ceive 230 volts, while lights connected to either one of the outside wires and the middle wire will receive 115 volts.

In practice, the power station doesn't use separate generators. A single high voltage is distributed to transformers where it is stepped down to give the two 115-volt sources, as shown in Figure 2.

"Grounding," "hot" wires, "live" wires, and "neutral" wires are terms with a special meaning to an electrician. But a layman is apt to be confused by them if he attempts to interpret them solely by the everyday meaning of the words.

In the words of the Code: "Circuits are grounded for the purpose of limiting the voltage upon the circuit which might otherwise occur through exposure to lightning or other voltages higher than that for which the circuit is designed; or to limit the maximum potential to ground due to normal voltage."

Why grounding? This is a procedure entirely for the protection and safety of

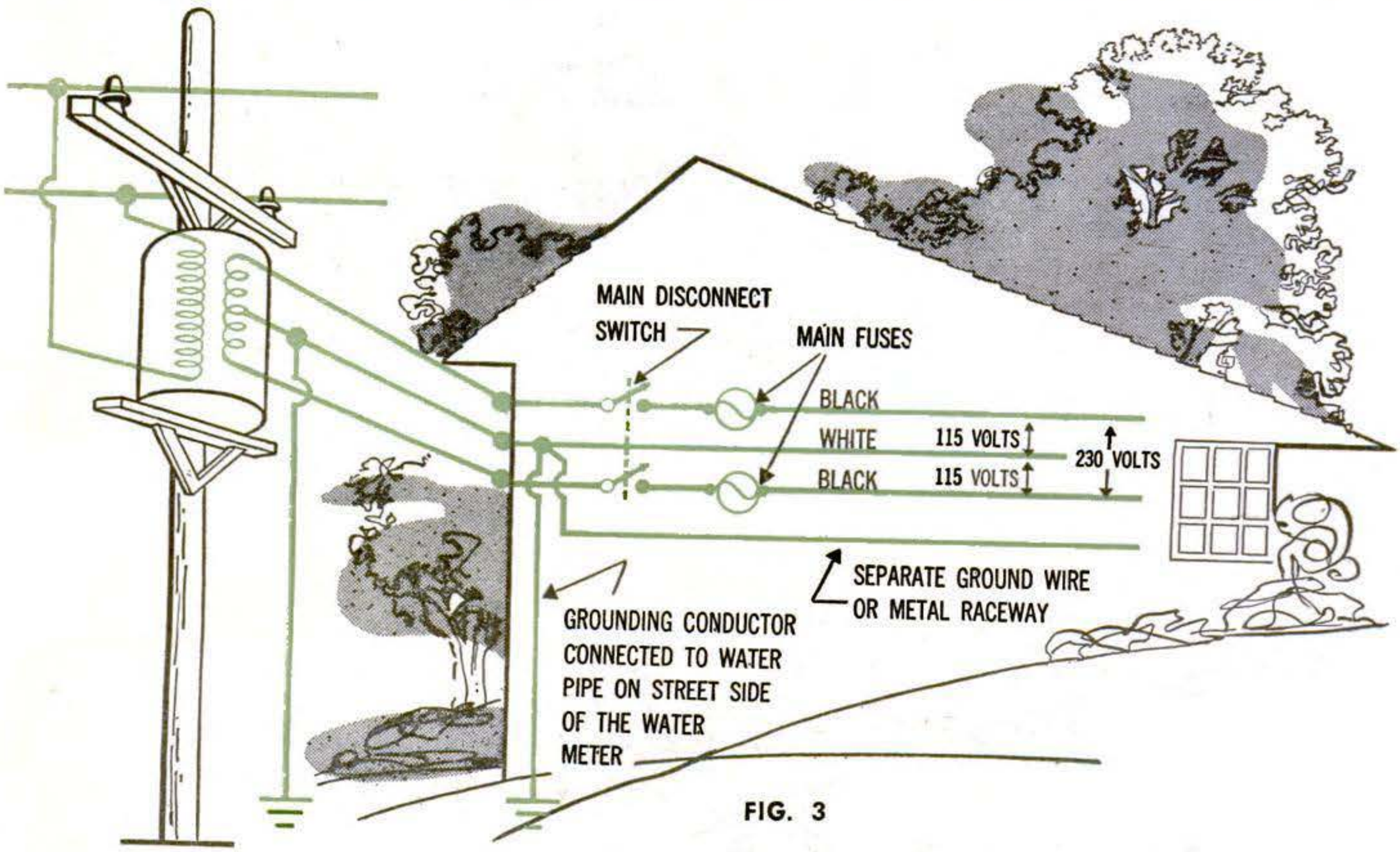

FIG. 3

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the installation. "Grounded" means connected to the earth or some other conducting body that serves in place of the earth. But unless the grounding is done properly, and unless all concerned—the power company, your electrician, and the appliance manufacturers—follow the same practice, a grounded system can be more hazardous than an ungrounded one.

The Code spells out in detail the exact manner in which circuits shall be grounded, what color wires are to be used, and how connections to the circuits must be made.

Figure 3 shows a grounded three-wire system. The conductor connected to the center tap of the transformer secondary winding is the one that is grounded. It is called the "neutral" wire. The two outside wires then become the "hot" wires with respect to ground. But, since there is only 115 volts between the neutral and either of the hot wires, none of the wires entering your house is more than 115 volts above ground. This is one way grounding contributes to your safety —115 volts is much less likely to be lethal than the 230 volts you'd have if the neutral were not grounded.

Neutral or hot? To maintain the identity of the conductors throughout the system, the Code requires that the neutral always be a white wire. The hot wires must be black, or some color other than white or green. The neutral must be grounded on the supply side of the main switch and must run to every 115-volt outlet in the house without interruption by switches, fuses, or other devices. In spite of the fact that it is called "neutral," it is a current-carrying conductor for the 115-volt circuits—it must be fully insulated and otherwise treated with the same respect as the hot wires. It is *not* and may *not* be used as a protective ground wire.

The protective grounding system runs throughout the house independently of the white wire, although both are connected to the system ground at the main switch. The protective grounding conductor may be the armor of BX cable, metal conduit, a bare wire inside a nonmetallic cable, or a green wire in a cord or cable.

Electrically, the distinction between the grounded conductor (white wire) and the protective ground conductor is that

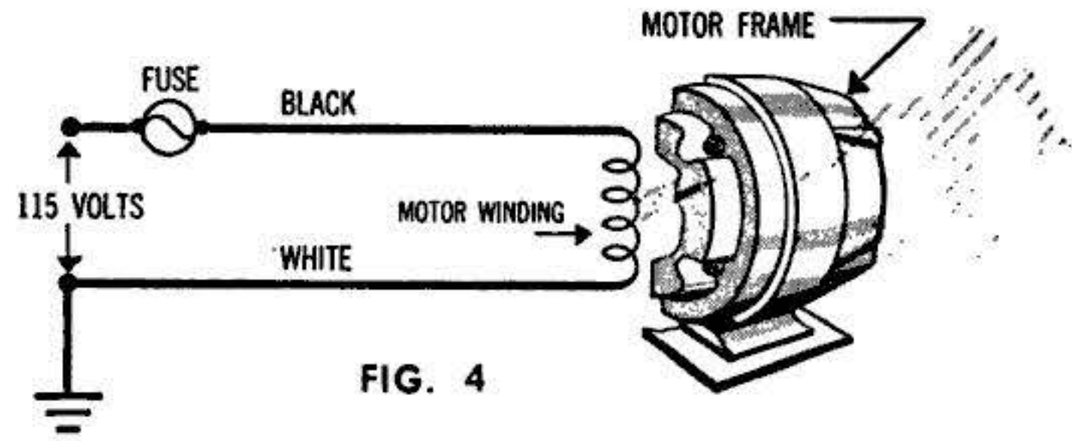

FIG. 4

the latter does not normally carry current. This is a point that frequently puzzles the layman.

That sneaky white wire. Our layman reasons that if the white wire is grounded, why not ground the metal enclosure of appliances to it? Why bother running a separate conductor just for a ground

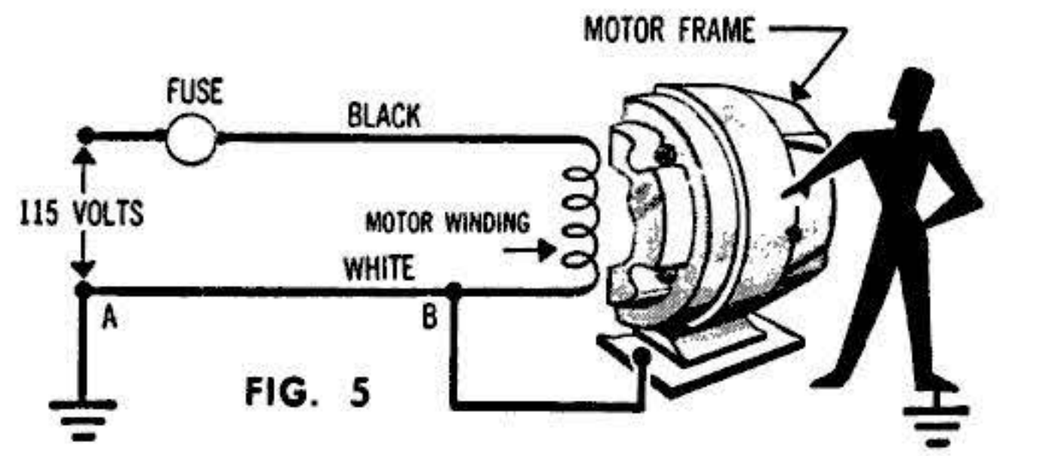

FIG. 5

when the white wire is grounded? This is a case where a little knowledge can be dangerous.

If a motor frame is not grounded (Figure 4), a fault from the motor winding to the frame will leave the frame hot. The fuse will not blow. Figure 5 shows the motor "protected" by a connection between the frame and the white

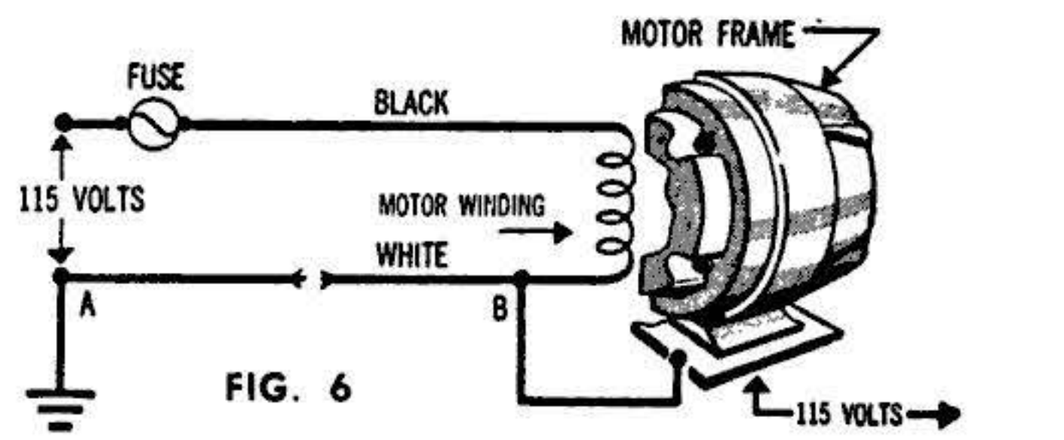

FIG. 6

wire. As long as the wire between A and B is intact and has negligible resistance, the motor frame will be at ground potential. If the motor winding should short to the frame, the fuse would blow, removing the voltage from the exposed metal parts. So far, so good.

But look what happens if the white wire is accidentally opened somewhere

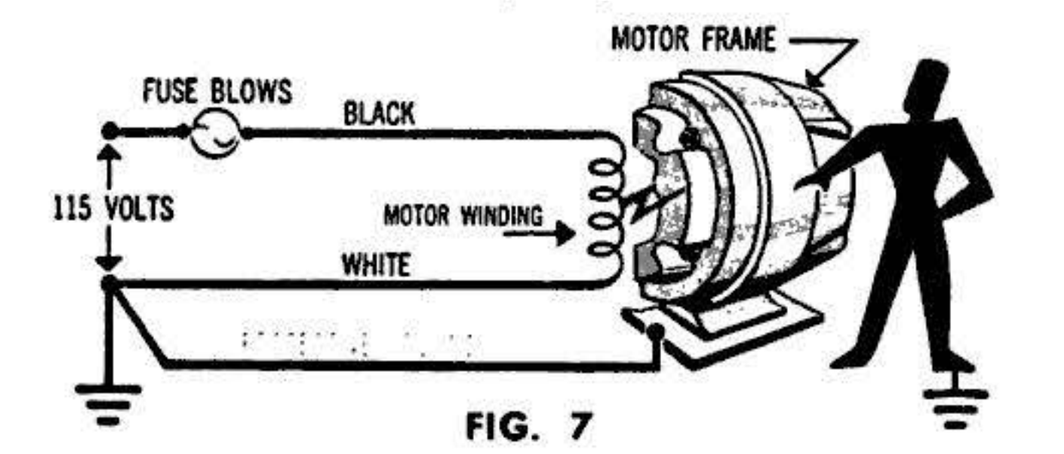

FIG. 7

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between A and B. (Figure 6). The hot wire is now connected directly to the frame through the motor winding. There is 115 volts between the motor frame and another ground.

Actually, the conductor between A and B does not have to be opened for a voltage to appear on the motor frame. Suppose a connection in the white wire somewhere between A and B had appre-

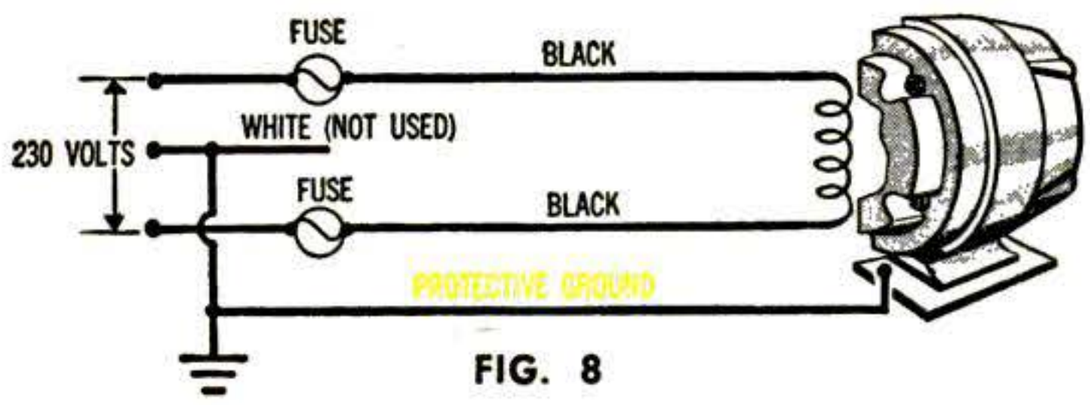


FIG. 8

ciable resistance—a few ohms would be enough. Then, depending on how much current was flowing in the circuit, there would be a voltage drop between A and B. This voltage would also appear between the motor frame and another ground.

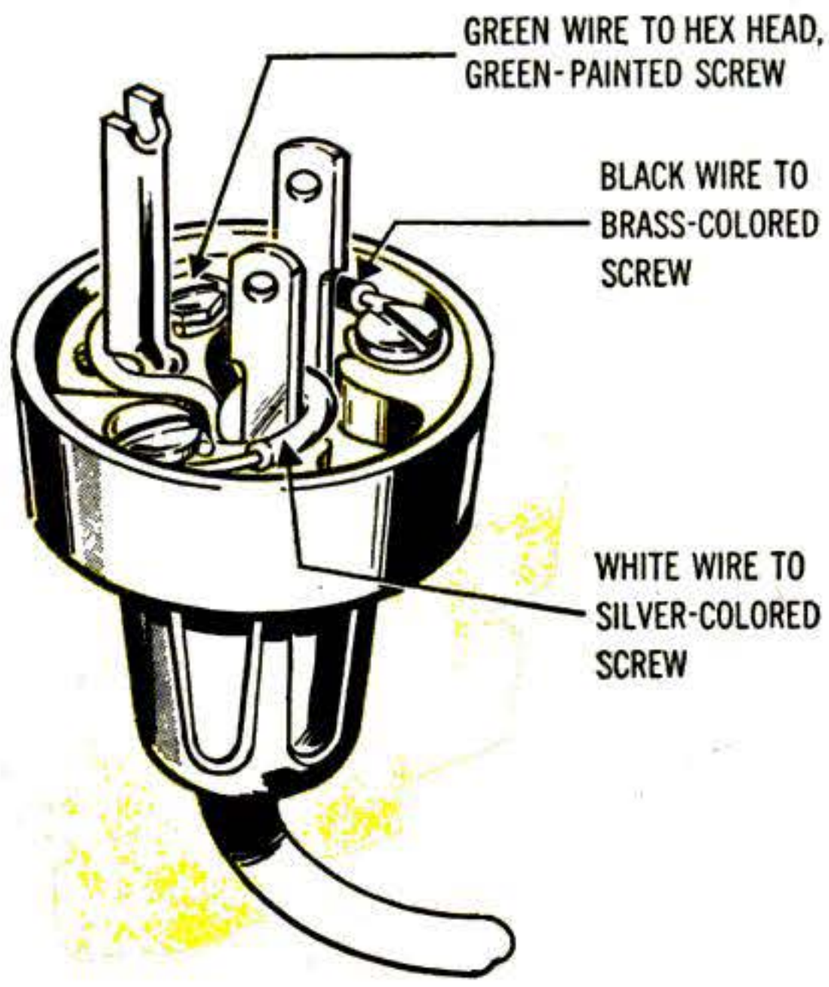
Creating dangers. In attempting to protect against one kind of hazard, another hazard has been created unnecessarily. Figure 7 shows the approved method of grounding exposed metal parts of a motor or appliance. A fault to the motor frame will still cause the fuse to blow, and the danger of deliberately connecting a current-carrying conductor to exposed metal has been eliminated. There is similar protection for the 230-volt appliance where the white wire is not used (Figure 8).

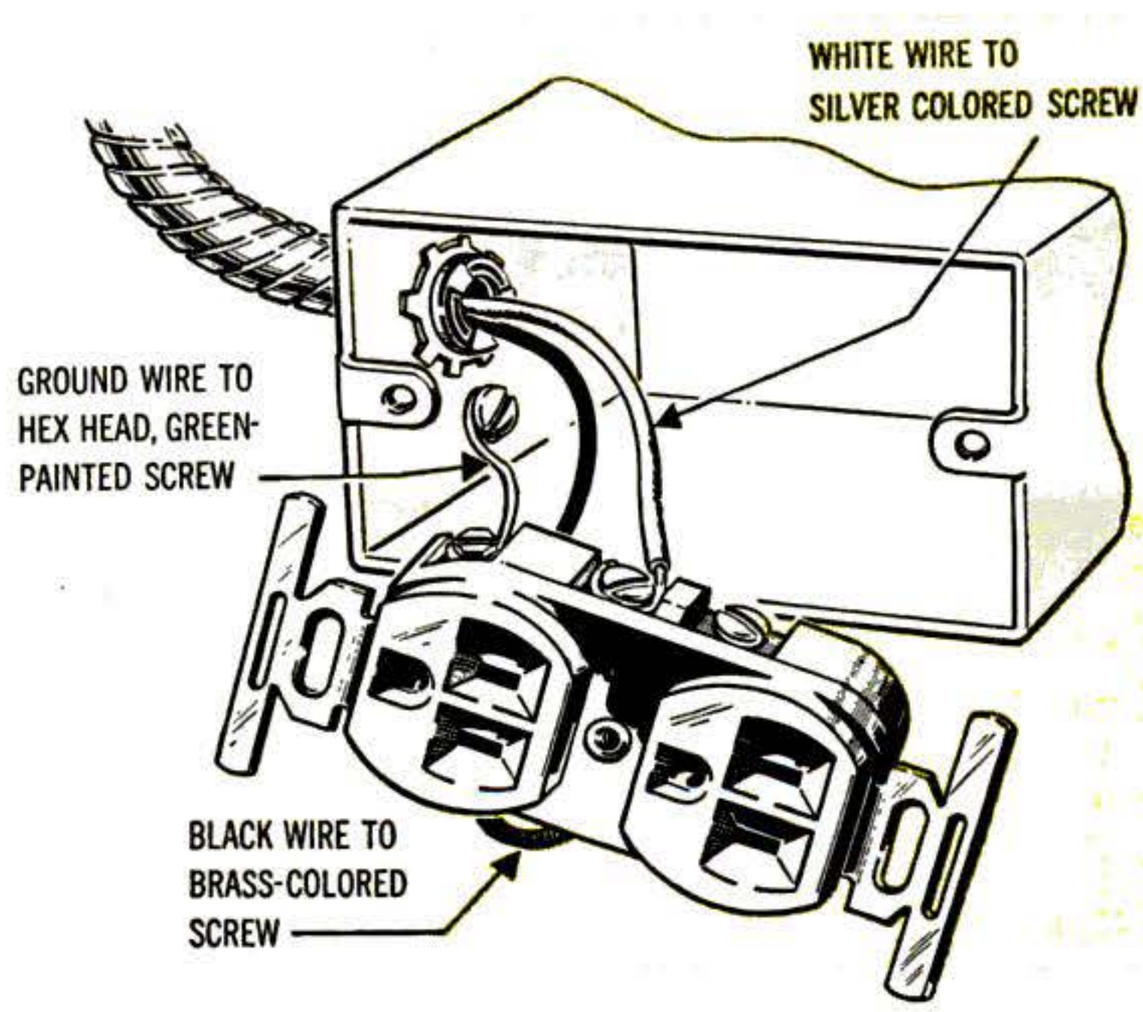
Notice, too, that although the white wire is not used for the 230-volt connection, its grounding back at the main switch limits voltage between the motor winding and the frame to 115.

Of course, if the protective grounding conductor is to serve its function, it must afford a continuous, low-resistance path back to the system ground. It is particularly important when BX cable or conduit is used that all mechanical joints be good electrical connections as well.

Safety in the shop. Portable electric tools and the outlets from which they are operated are of special concern to home workshoppers. Most tools you'll buy will now have three-wire cords and grounding plugs. The green wire in the cord is electrically connected to the metal case of the tool at one end and to the grounding blade of the plug at the other. The ground terminal in the plug to which the green wire is connected is different in appearance from the other two and is usually daubed with green lacquer.

The adaptors for the grounding plug in a conventional outlet are, at best, a temporary makeshift. Too often, the pigtail grounding wire is not properly grounded. For reliable protection, the outlets where the tools are likely to be used should be changed to the grounding type. The grounding conductor of your house wiring (armor, conduit, or ground wire) is connected to the green terminal of the new outlet. The white wire is connected to the silver-colored screw, and the black wire is connected to the brass-colored screw. Continuity of the ground circuit should be checked after the outlet is installed. It is not safe to assume that the metal box is grounded unless an electrical test has been made.





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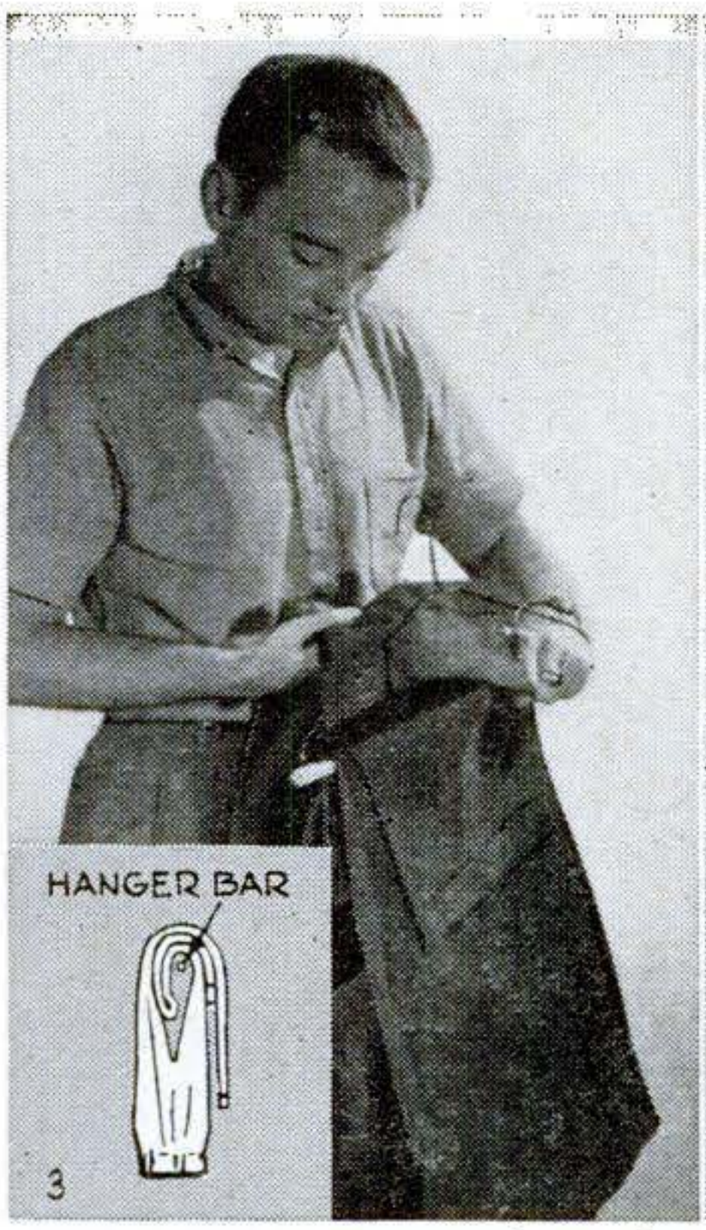
FOLD ONE LEG DOUBLE so that its end is level with the crotch seam. Insert the hanger between the trouser legs.

DRAW FOLD OVER BAR and tuck it down against the crotch seam. Be sure creases are smooth to prevent wrinkles.



PUSH STRAIGHT LEG through the hanger and across folded one until it is smooth. This locks the trousers in place.

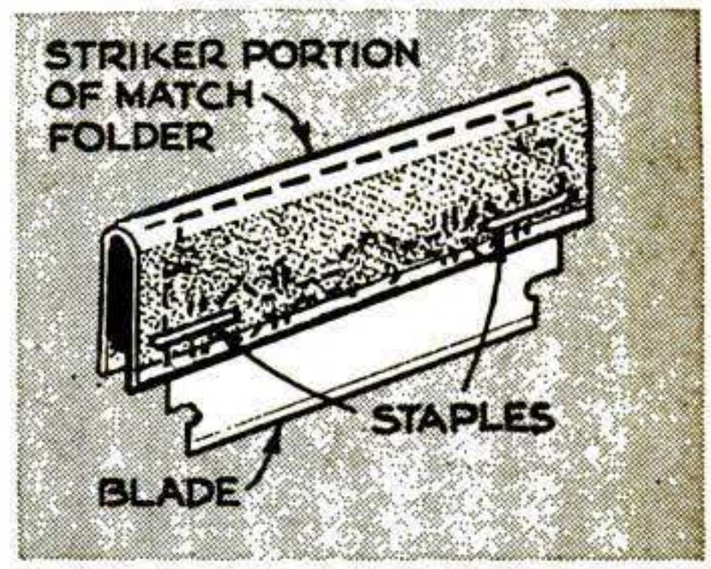
SLIP JACKET ON TOP and hang your suit from the hook in the back seat of your car. The pants will stay put.

Hanging Trousers for Neat Travel

WHETHER you travel with your suit hung from a back-seat hook or in the closet of a house trailer, you've probably had to pick the trousers off the floor. Slung over the pants bar of a coat hanger, they usually jiggle out of balance and slide off. They won't, if you fold them as shown above.—*Ray Moore, Wellsville, Ohio.*

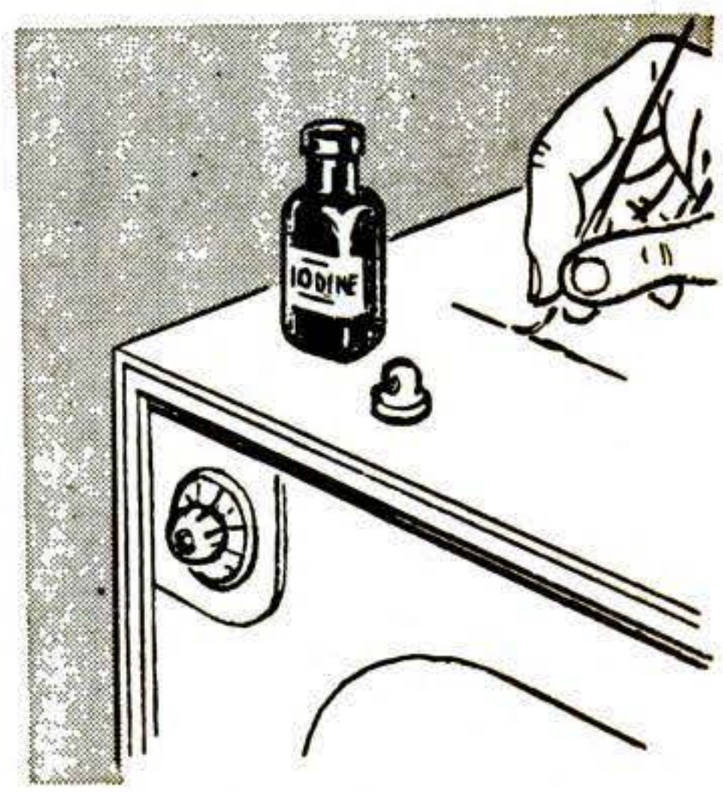
Short Cuts and Tips

FROM PS READERS



Safety Sleeve for Razor Blade

NEVER cut with a double-edged razor blade without protecting your fingers from the edge that's not in use. Insert this edge in a strike-plate fold snipped off a matchbook. It masks the blade and provides a slip-proof grip. Secure with two staples.—*Francis J. Arsenault, Ft. Wayne, Ind.*



Iodine Heals Finish Scratches

MINOR scars on finished furniture can usually be stained with iodine. Use a small cotton swab or artist's brush. Repeated applications are necessary to match a dark stain, but for light finishes the iodine should be diluted with water until you get it right.—*Charles Carroll, Marion, Ohio.*

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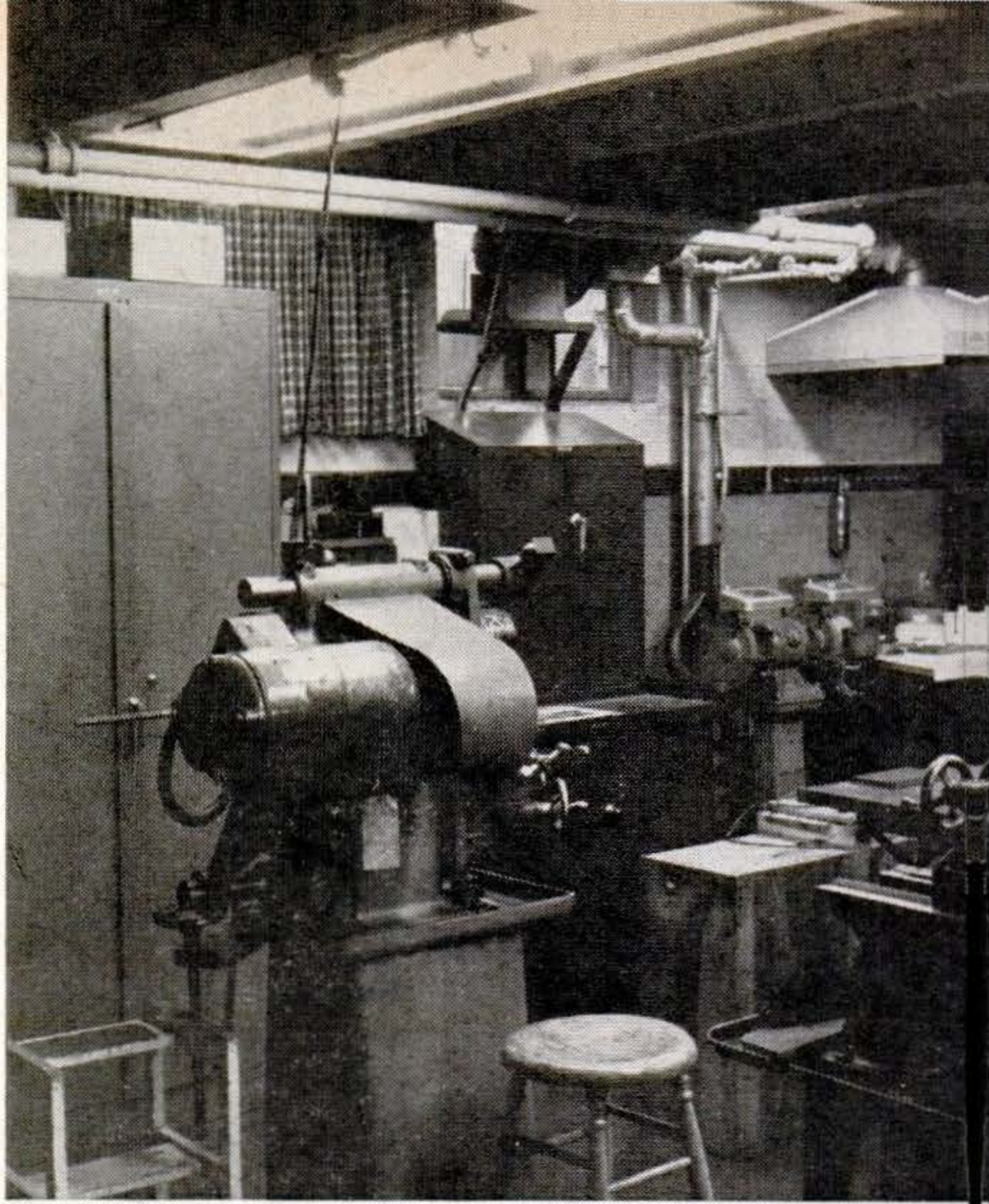
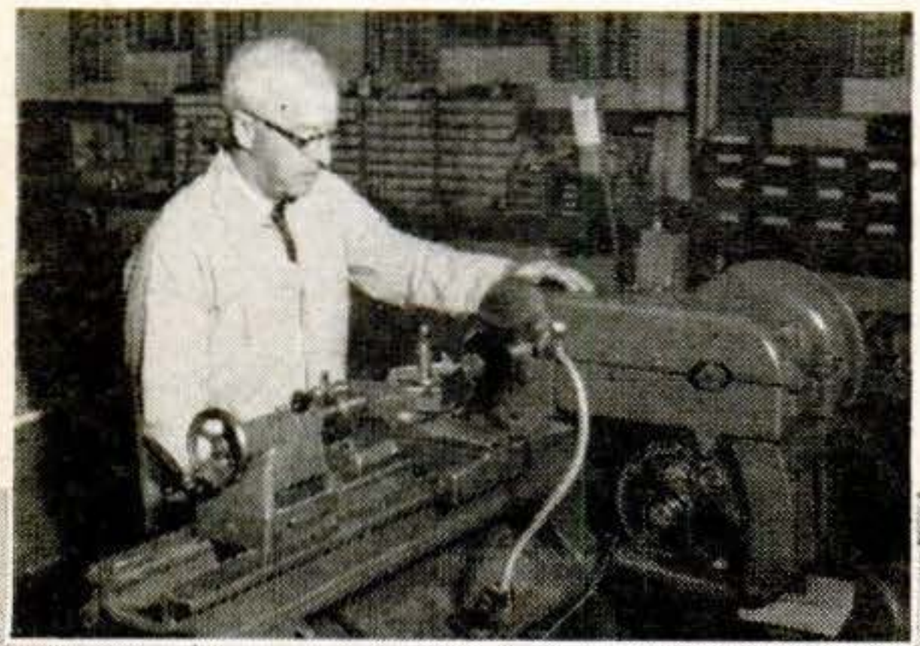
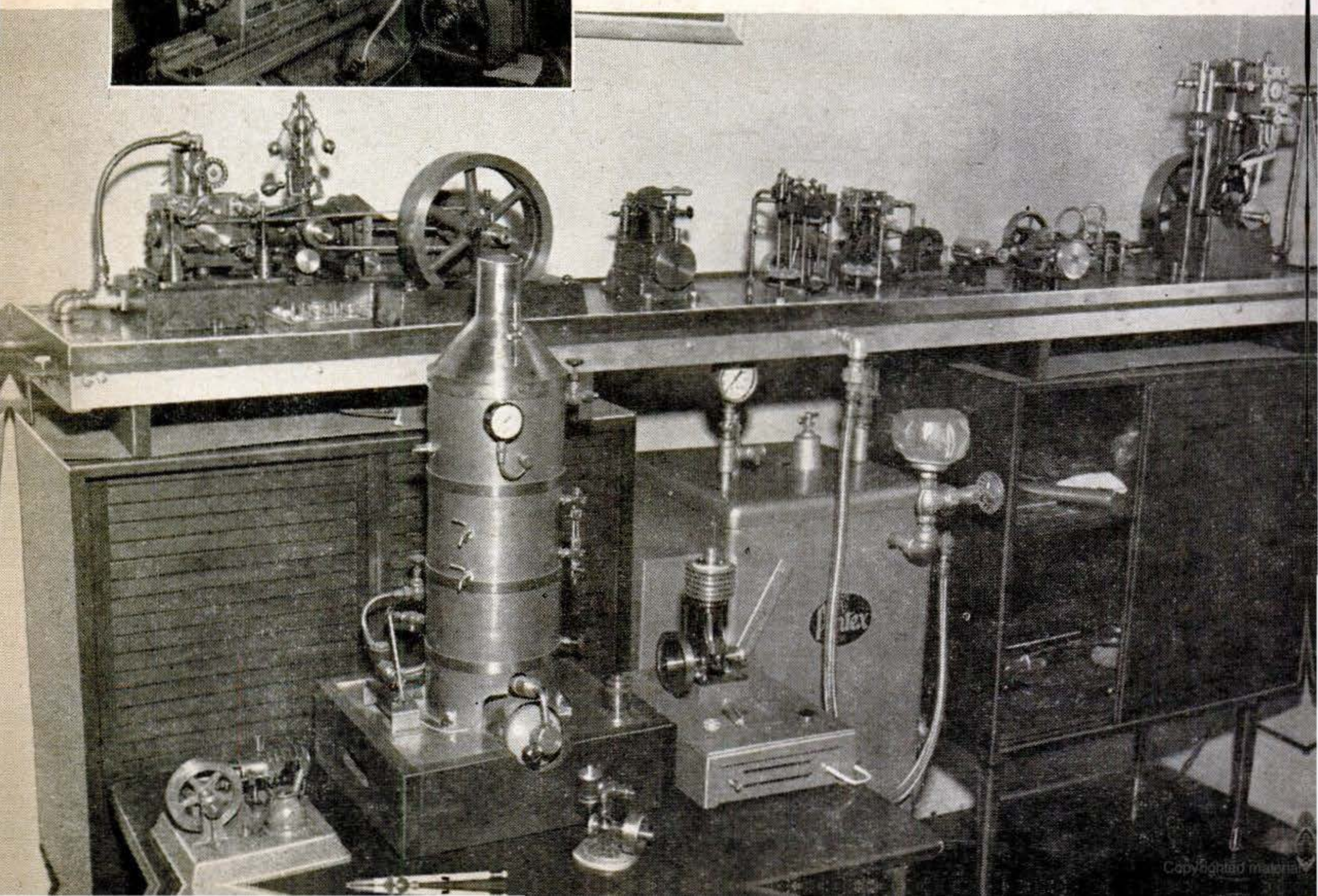
The Prize Shop of a Popular Science Reader

This craftsman not only has tools anyone would like—his projects show he can use them skillfully





BATTERY OF MODEL ENGINES in the Ayres office (below) includes seven connected to steam main fed by generator under shelf. At left, Ayres sets up one of his lathes to turn a part for yet another working model.



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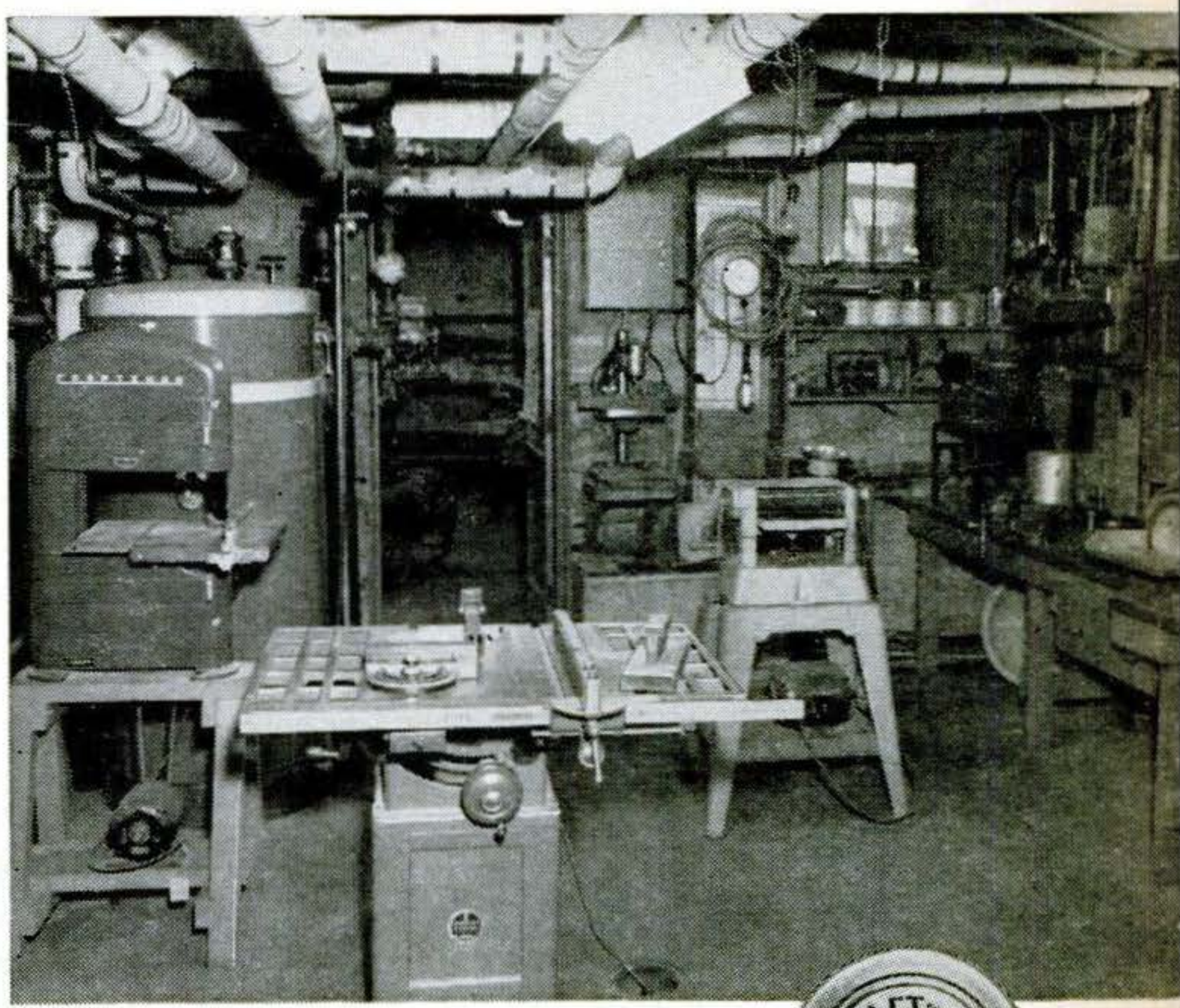
DOES something disturb you in the picture above? Maybe it's those homey touches, unexpected in a machine shop: the plaid curtains, the college pennants, the tile floor.

These are remnants of the rumpus room that used to occupy this basement space in the home of A. O. Ayres, president of a sand and gravel company in Eau Claire, Wis.

The 24′-by-25′ room is now full of precision metal-working machines, including lathes, grinders, punch presses, buffing wheels; a milling machine, drill press, shear, brake, notcher, binder; electroplating and oxy-acetylene welding equipment. There's also a gas-fired furnace for bronze and gray-iron castings, and a special exhaust system to carry off fumes and metal dust. In this shop Ayres turns out the model engines that are his



WOODWORKING SHOP, adjacent to machine shop which can be glimpsed through the door, includes bandsaw, 9″ bench saw, drill press, thickness planer, sander, many smaller tools (such as the miter cutter illustrated on the next page) and five workbenches. At right is the brass nameplate that identifies all products of the Ayres workshops.

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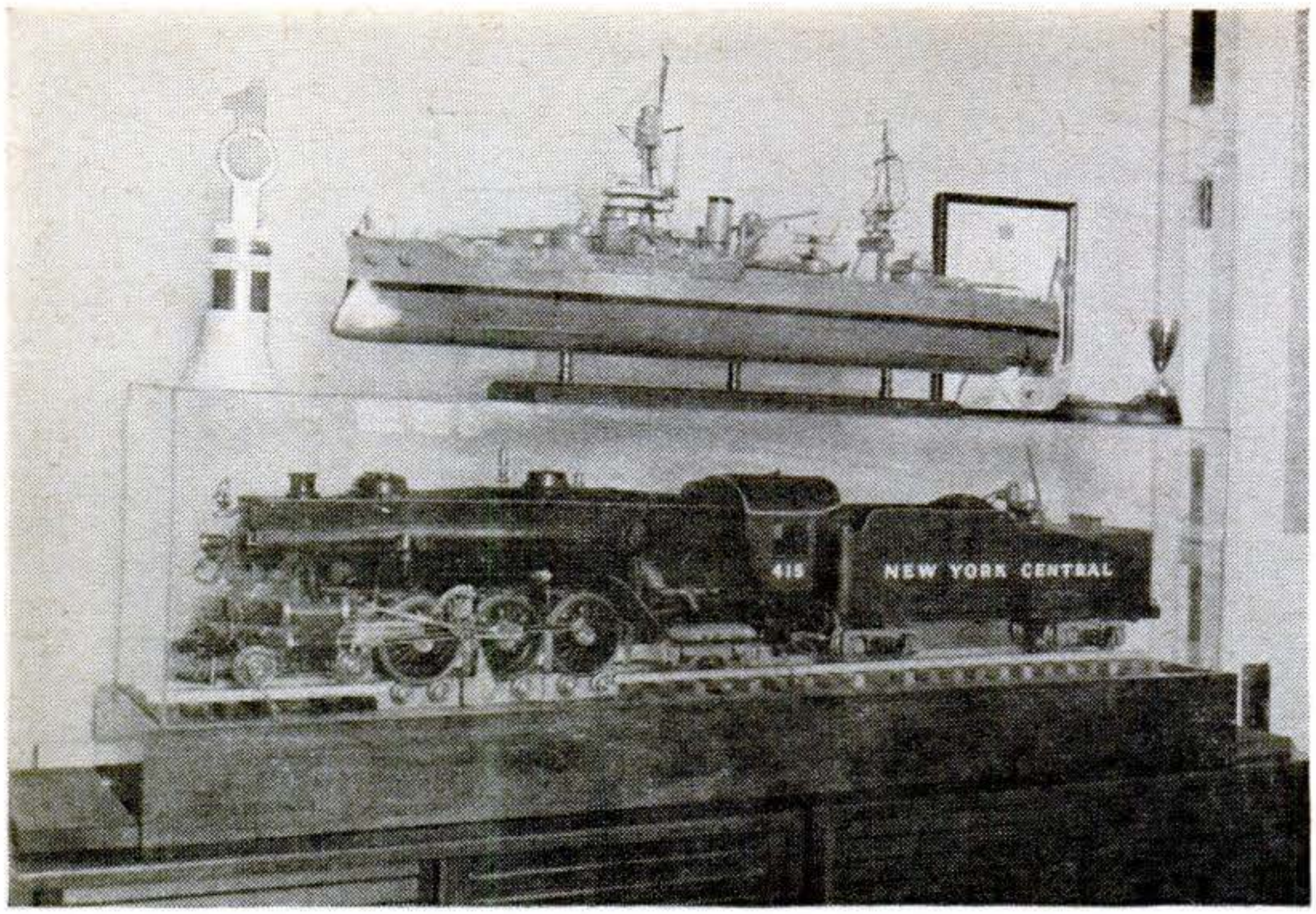
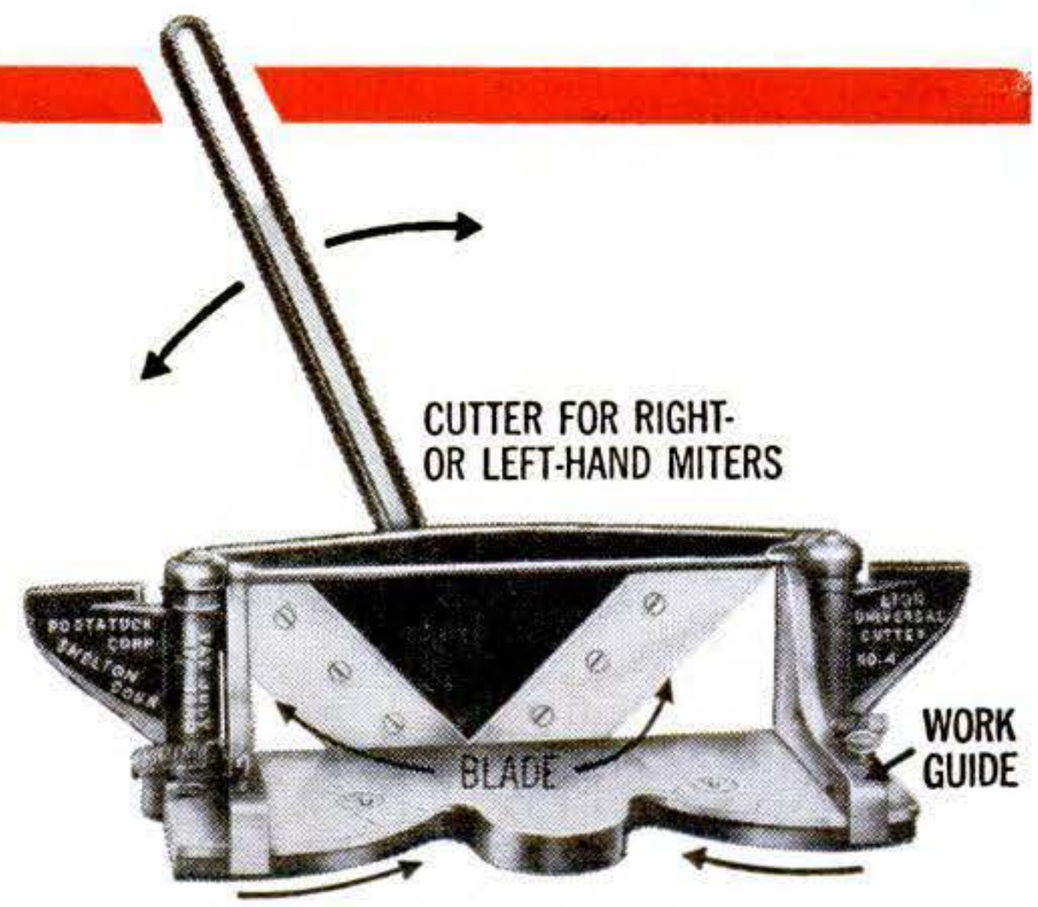


WORKING MODELS in another office display include the old battleship Texas, with its two propellers powered by dry cells and a six-volt auto-horn motor, and a 4-6-4 ½"-scale Hudson locomotive fired with coal or charcoal. The latter took Ayres 3,000 hours to build.

specialty. His office whirs with the action of over a dozen display engines—some powered by electricity and a whole shelf of them operating off a special steam rig. A few were built from scrap material; some were assembled from castings and miniature valves purchased from Charles Cole of Ventura, Calif., and others. Two were built from descriptions and plans published in PS.

My Most Embarrassing Shop Moment



THE equipment in my woodworking shop includes a miter cutter made by the Pootatuck Corp., Shelton, Conn.—a rather unusual tool for a home shop. It's largely used by picture framers for making a finishing cut on an angle already sawed by miter gauge. There's a reason why I own it.

When I was 18, I took a course in wood and pattern work. Noticing that a project was giving me a hard time, a "smart" gent at the next bench said: "You're foolish to go to all that trouble on joints. Why not finish off the job to your scribed lines on that miter cutter over there? Just be sure to cut the pieces a little long."

I did—and turned in the job. At the next class hour, I found a note on my bench to see the instructor.

At the interview, he smiled and said the work was perfect, far superior to anything turned out by any student for years. I was beginning to feel a bit smug, but came out of it fast when he said: "Your mark is zero."

Stammering questions, I learned that the instructions on the drawing specified handwork only. My face was certainly red but, remembering all that previous lavish praise, I decided then and there that some day I was going to have a miter cutter of my own.—*A. O. Ayres, President, Eau Claire Sand & Gravel Co., Eau Claire, Wis.*

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Do you have an embarrassing shop blunder that haunts you? PS will pay $50 for each such experience published. None can be returned. Keep it brief. Address: Shop Editor, Popular Science Monthly, 355 Lexington Ave., New York 17, N. Y.

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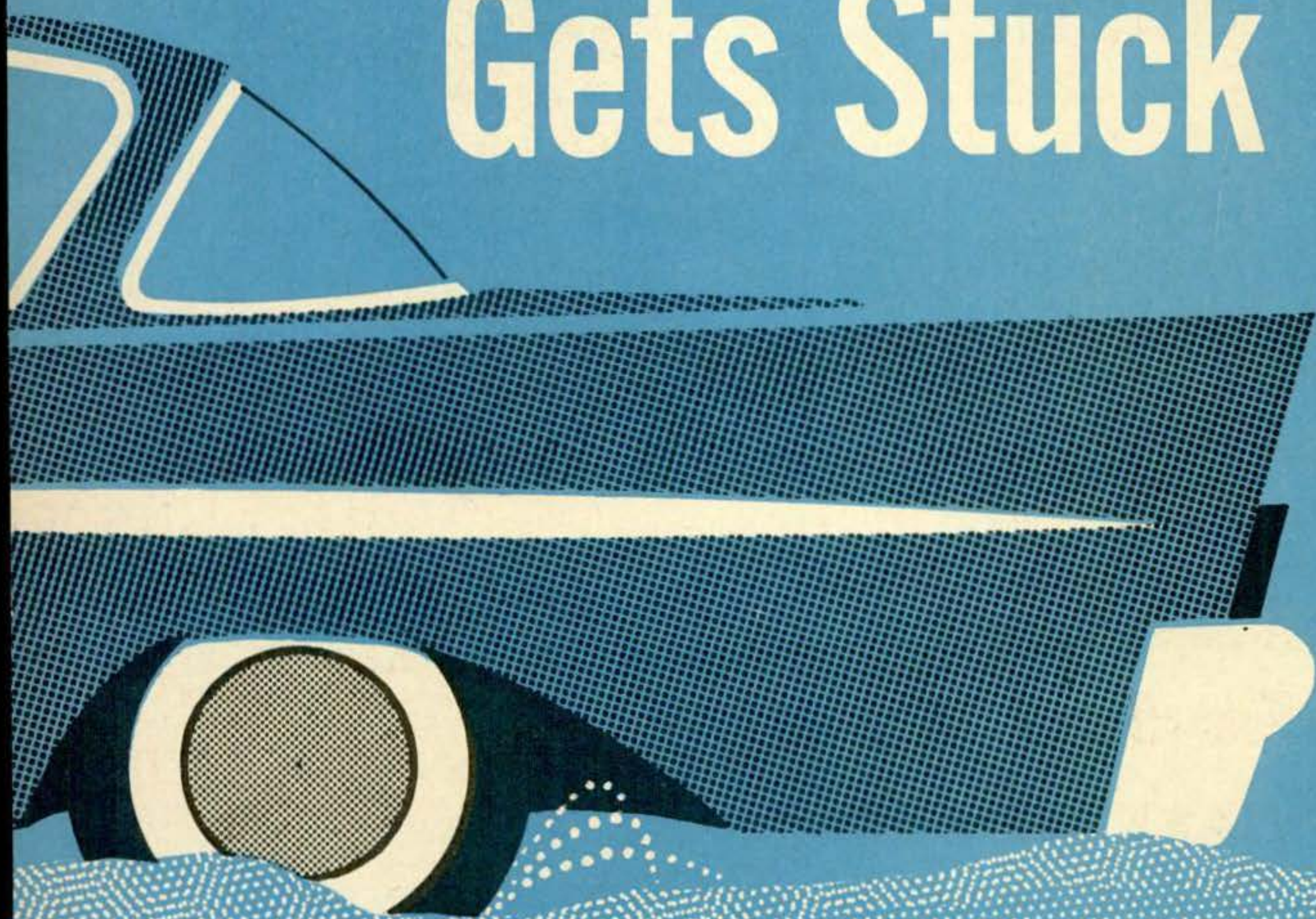
POPULAR SCIENCE BONUS BOOKLET NO. 18

What to do When Your Car Gets Stuck



How to get going again if you bog down in snow, ice, sand, mud, or a ditch

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When your car gets stuck

THE engine runs, and a wheel turns—but your car goes nowhere. You're stuck in snow or ice, mud or sand, a rut or a ditch.

Should you call a tow truck? Yes, if there's a phone handy and you have time and money to burn. Or open the trunk for a stock of emergency equipment? That's fine, too—if you don't mind carting around hundreds of pounds of sandbags, chains, spades, and other paraphernalia.

But suppose you're stuck without help and with little or no equipment. Nine times out of ten, you can *still* get rolling—by a combination of technique and ingenious ad libs. This booklet, compiled by the PS staff with the cooperation of the American Automobile Association, will tell you how. Read it through once—get other drivers in your family to read it—and then keep it in the glove compartment. Maybe you'll need it.

When you see trouble coming

THE cagey driver tries to avoid trouble before it starts. When a car threatens to bog down, he fights the impulse to jam on the brakes, cramp over the wheels, or mash the throttle. He also remembers these simple rules:

- Don't stop in sand, mud, or deep snow if you can possibly help it; momentum is invaluable in everything except when you ford deep water. When you *must* stop, try to pick a spot facing downhill, or at least on level ground. If you get stuck on an uphill slope, back down to level ground.
- In sand, snow, ice, or wherever the going gets rough, keep your wheels as nearly straight as possible.
- Applying your brakes in sand is a good way to get bogged down. Let the car roll to a stop.
- On a beach, don't risk driving too near the water.
- On ice, don't start in first (or low, if you have automatic shift); you'll just increase wheel spin.
- Don't cross a flooded section of road unless you're certain that the depth of the water permits fording. Generally more than an inch or two above the center of the hubcaps is risky. Your engine will die if the water level is above your exhaust pipe.
- Don't blast through deep water or race the engine. The wheels and speeding fan will throw up enough spray to wet out your ignition.

Play it cool and cagey

IF IN spite of precautions you still get stuck, don't try to gun your way out without first studying the situation. Spinning a wheel will almost certainly make matters worse.

Instead, walk around the car. See if you can scavenge something nearby that will help you out of your predicament. An old fence post can double as a crowbar. A discarded carton may give you traction on slippery going. A driftwood plank can be a sand shovel.

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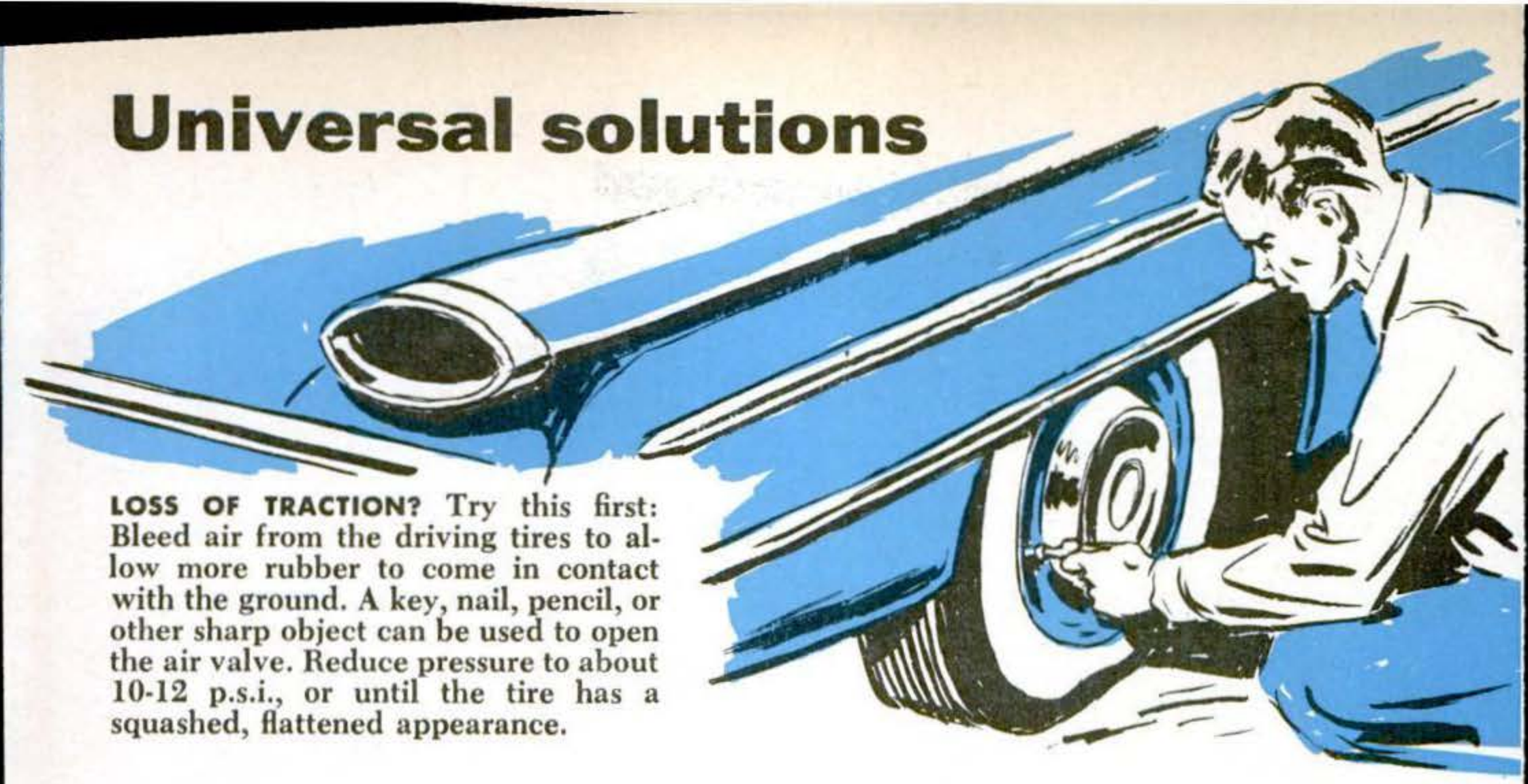
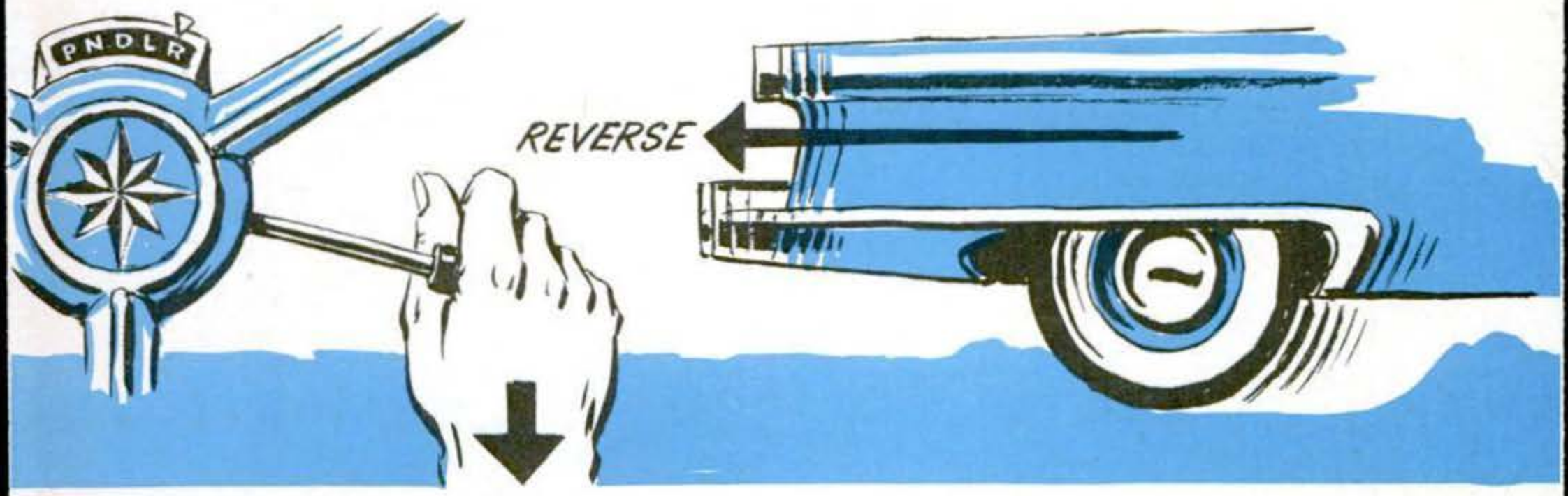
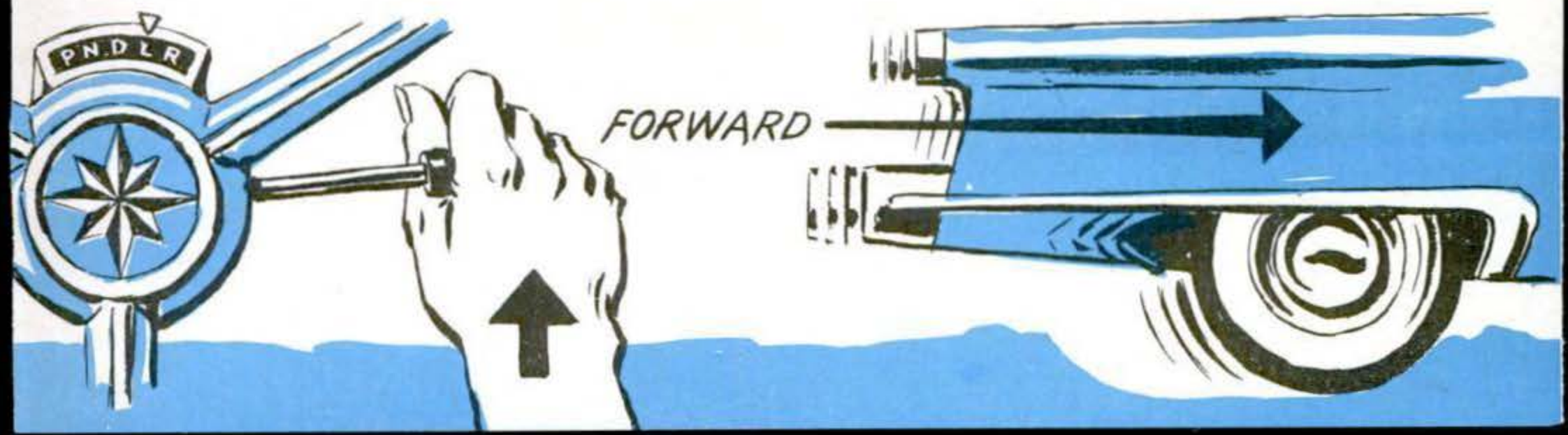
Universal solutions



LOSS OF TRACTION? Try this first: Bleed air from the driving tires to allow more rubber to come in contact with the ground. A key, nail, pencil, or other sharp object can be used to open the air valve. Reduce pressure to about 10-12 p.s.i., or until the tire has a squashed, flattened appearance.



ROCKING BACK AND FORTH is a basic maneuver when you're dug into snow, sand, or mud. Shift into reverse and apply power very gently. The instant the wheels lose traction and begin to spin, shift quickly into low. Apply power lightly and increase gradually until the car nears the end of its forward motion. Ease off on the gas and, as the car starts sliding backward, shift into reverse once again. Set up a rhythmic, pendulumlike rocking motion. With each swing, the car's travel should increase slightly. Remember, a spinning wheel is the enemy of traction. Passengers can help by pushing along the car's side.



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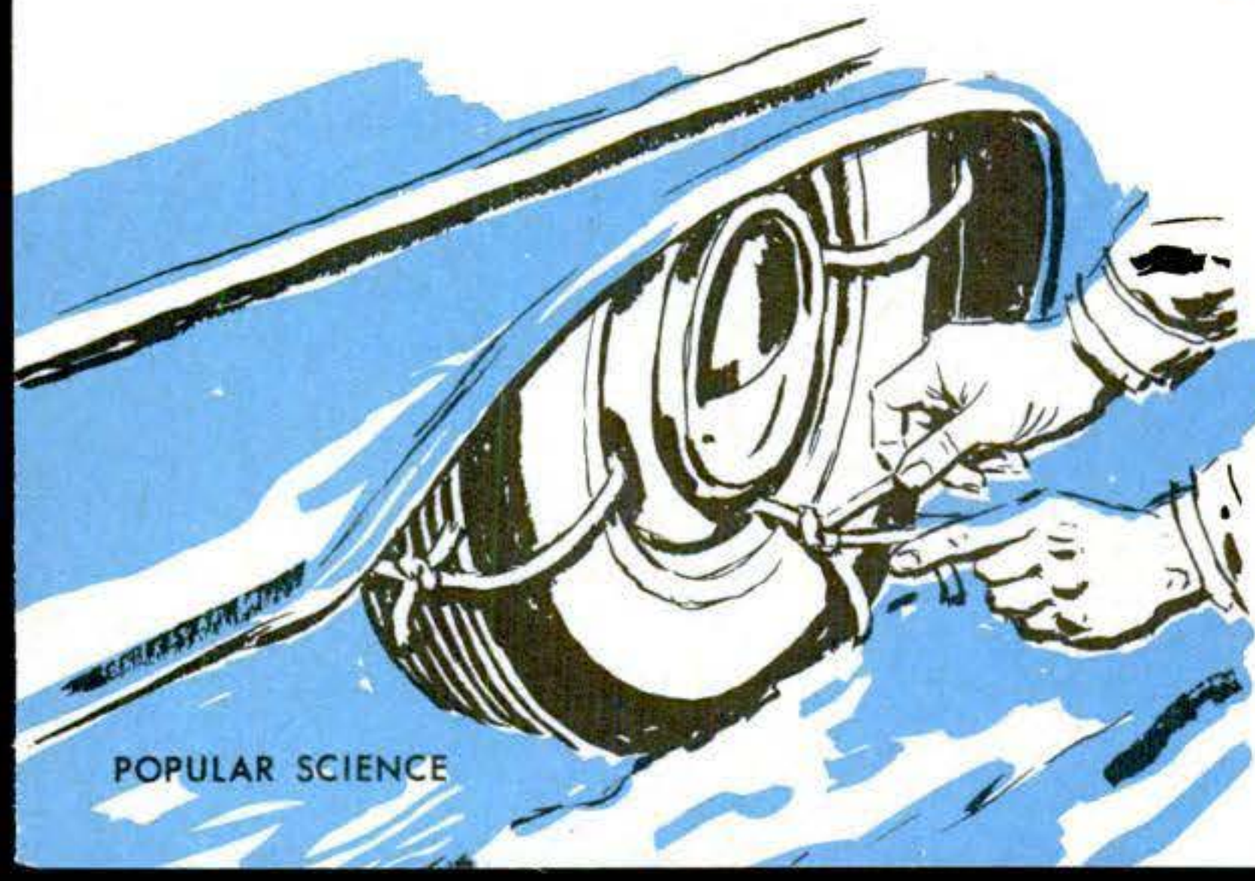
Getting traction on snow and ice

MOUNTING TIRE CHAINS is a dirty job when you're stuck. If a small patch of snow or ice is causing the trouble, try simply spreading the chains in front of the driving wheels as a temporary runway. Tie cords, if available, from chains to rear bumper to drag them to dry ground.

NO CHAINS IN YOUR TRUNK? Rubber floor mats from the passenger compartment or trunk can come to the rescue. Wedge them in front of driving wheels. Newspapers, twigs, leaves, and trash also may be used.

IS YOUR PARKED CAR SNOWBOUND from a passing snowplow? If there's no shovel handy, dig yourself out with the scooplike base of a bumper jack. In some station wagons, a removable floorboard over the spare makes a fine shovel.



IF YOUR CAR has perforated wheels, plain clothesline can get you out of deep snow. Run three or four small sections of line through the holes in the wheels and tie knots on the face of the tread for maximum traction. When you hit dry road, the rope will wear off and fall away harmlessly.

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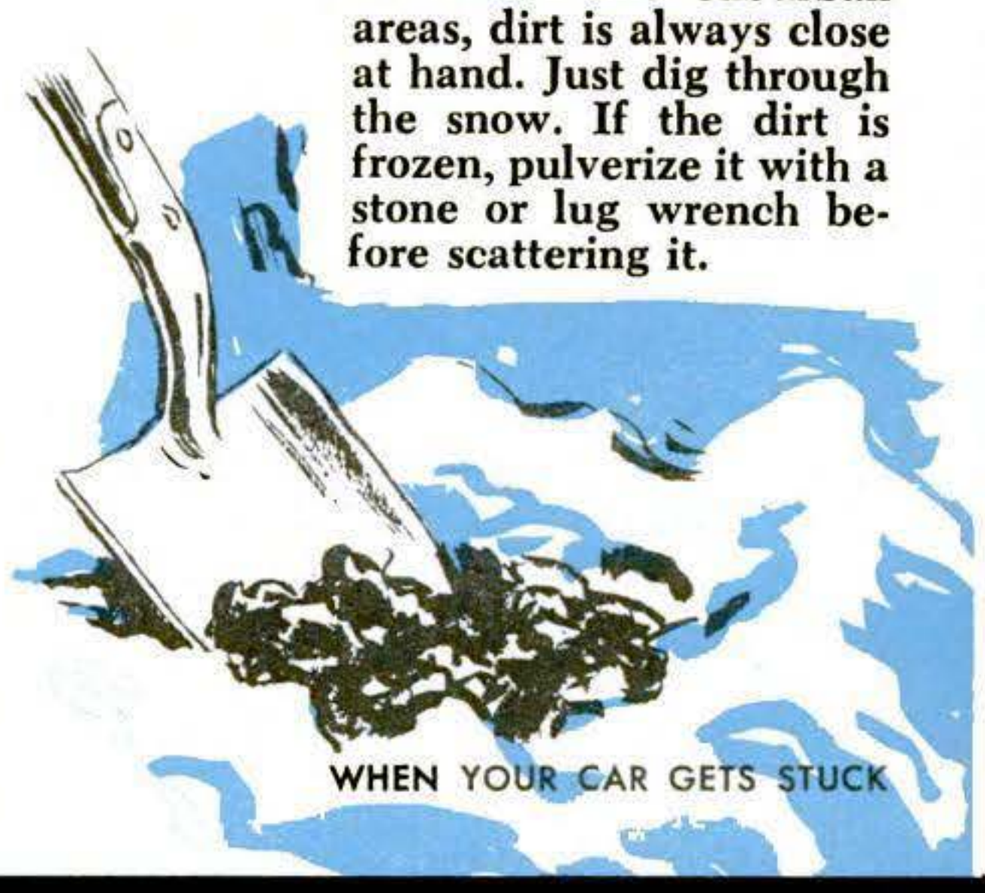
EVER WISH FOR SOME HOT WATER so that you could quickly melt a patch of ice? Just warm up the engine and drain a pint or so from the radiator. The stopcock is at the bottom of the radiator and can be found by either lifting the hood or reaching under the bumper. A wheel cover makes a handy container.

BUILT-IN SUPPLY OF DIRT? Just take a look. It builds up inside fender wells, where its thrown by tires. Rap the fender with the palm of your hand to dislodge the dirt. Sprinkle on ice around the wheels, and you're off.

THAT ANNOYING DIRT that always seems to be on your car floor no matter how often you sweep can do you a good turn when you're stuck on ice. Sweep it onto a road map and sprinkle in front of the driving wheels.

DON'T STAND BEHIND A CAR when the driver is trying to pull out of a slippery spot. The spinning wheels may kick up debris, causing you serious injury. Never try to push a car from behind if foreign matter has been propped in front of its wheels.



IN RURAL and suburban areas, dirt is always close at hand. Just dig through the snow. If the dirt is frozen, pulverize it with a stone or lug wrench before scattering it.

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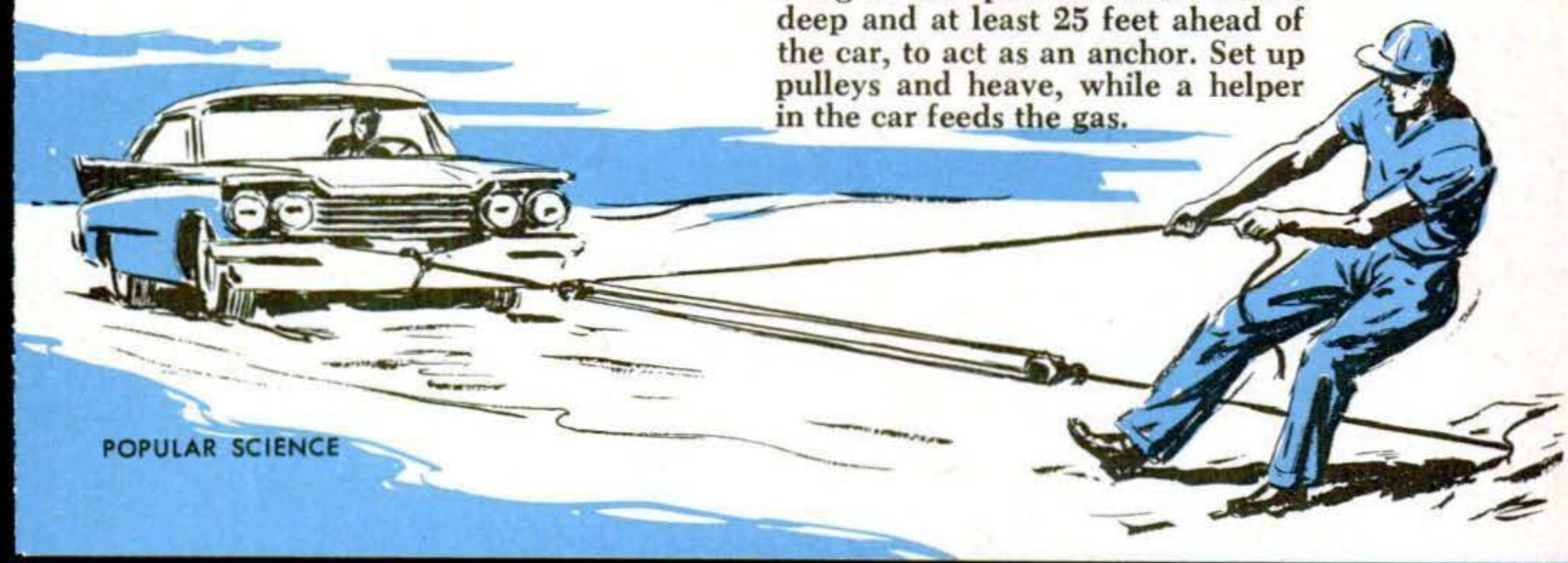
Digging out of sand

ARE YOU A HERCULES? You don't need to be, to lift a car's dug-in wheels. Place a jack in the middle of the rear bumper and, using the spare wheel as a support, lift the wheels out of the ruts. Push the car sideways until it falls off the jack. Then fill in the ruts with stones and sand or other rubble to prevent the wheels from slipping back in.

DIGGING A RUNWAY is a laborious but almost sure-fire way of getting out of loose beach sand, where firm footing is often only five or six inches below the surface. Dig at least one car length ahead. Apply power slowly; after you're rolling, gun the engine.

A BLOCK AND TACKLE, though not normally carried by motorists, is a good investment if you do much driving in sandy or muddy areas. Special compact rigs are available in auto-accessory stores. If there's no good hitching point nearby, bury a log or the spare about six inches deep and at least 25 feet ahead of the car, to act as an anchor. Set up pulleys and heave, while a helper in the car feeds the gas.



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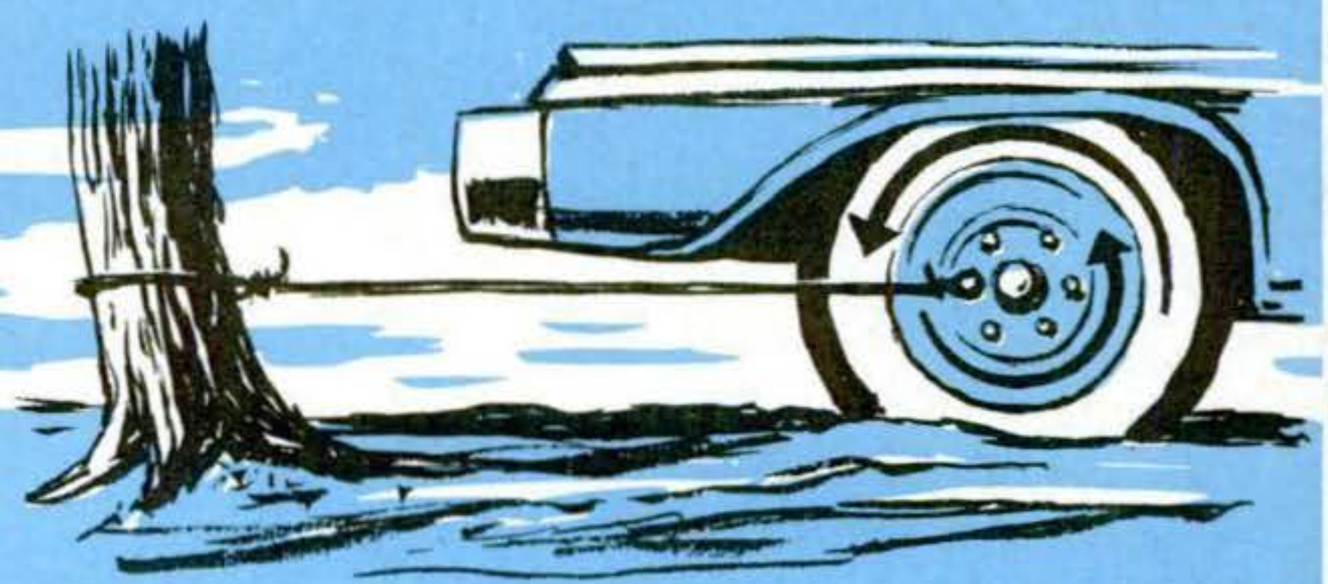
IF A FAMILY OUTING on the beach ends up with your car bogged down, send the kids out scavenging for driftwood planks. Jack up the car wheels and place planks underneath. Form a runway at least one car length ahead, and lay timbers crosswise under the planks to prevent tipping. Watch out for nails in the wood; place bad sides downward.

Pulling out of mud

WHERE THERE'S MUD, there are bound to be weeds nearby. Uproot several handfuls and drop them, along with roots and topsoil, behind the driving wheels.

TREMENDOUS MECHANICAL ADVANTAGE is available for a few inches of travel at a time if you can borrow a length of rope or wire. Tie a long piece tautly to a bumper and to a tree or other support. Then push sideways in the middle while a helper in the car applies power. After the car moves, apply brakes, retighten rope, and repeat the procedure.

YOUR WHEEL LUGS are good for moving your car a few inches at a time if you can find rope or wire. Loosen the rearmost lug on each driving wheel, stretch a long rope around a tree or other anchor, and tie the ends tautly to lugs. As the wheels make half a turn and lugs assume opposite position, your car will move about six inches.



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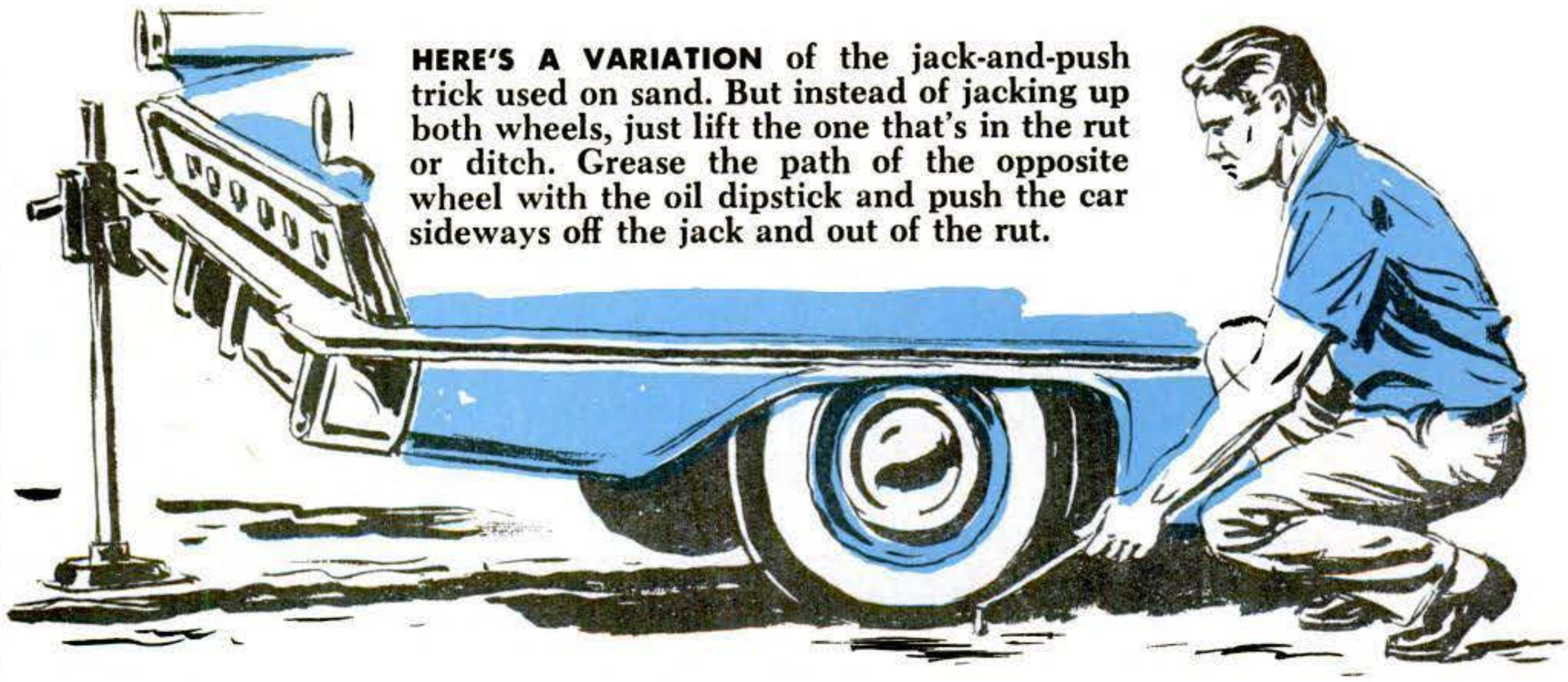
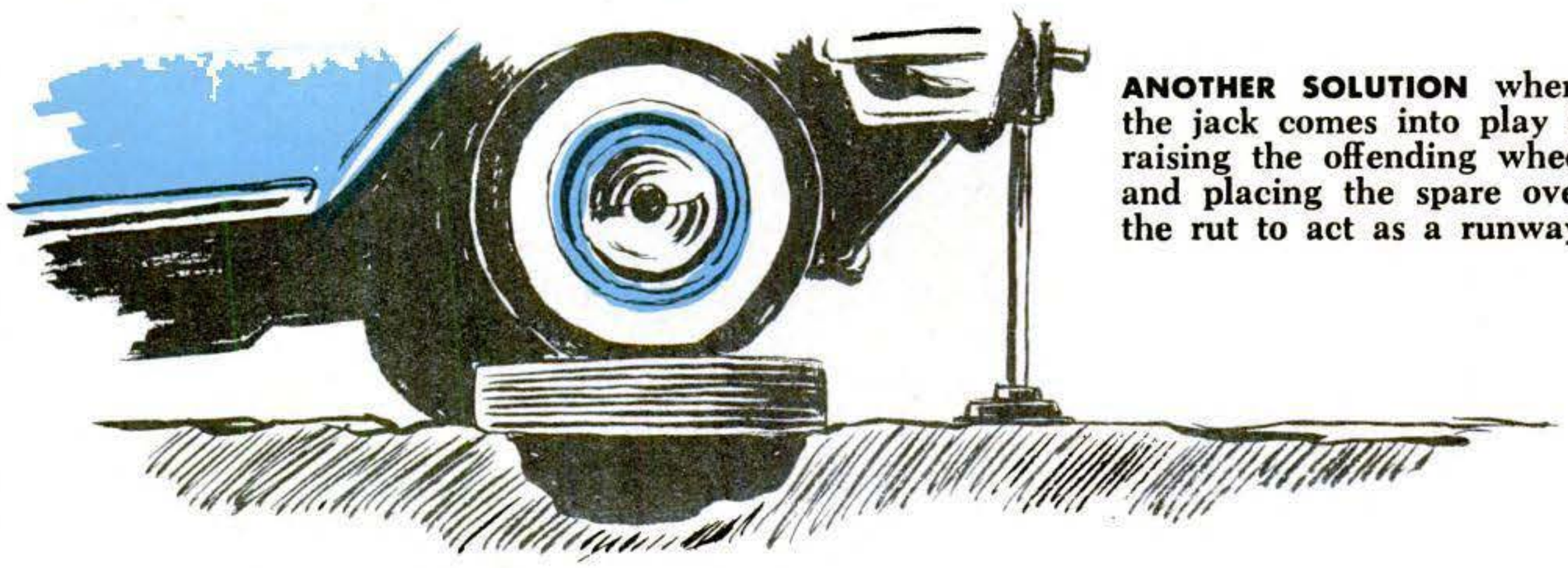
Wheel in rut or ditch



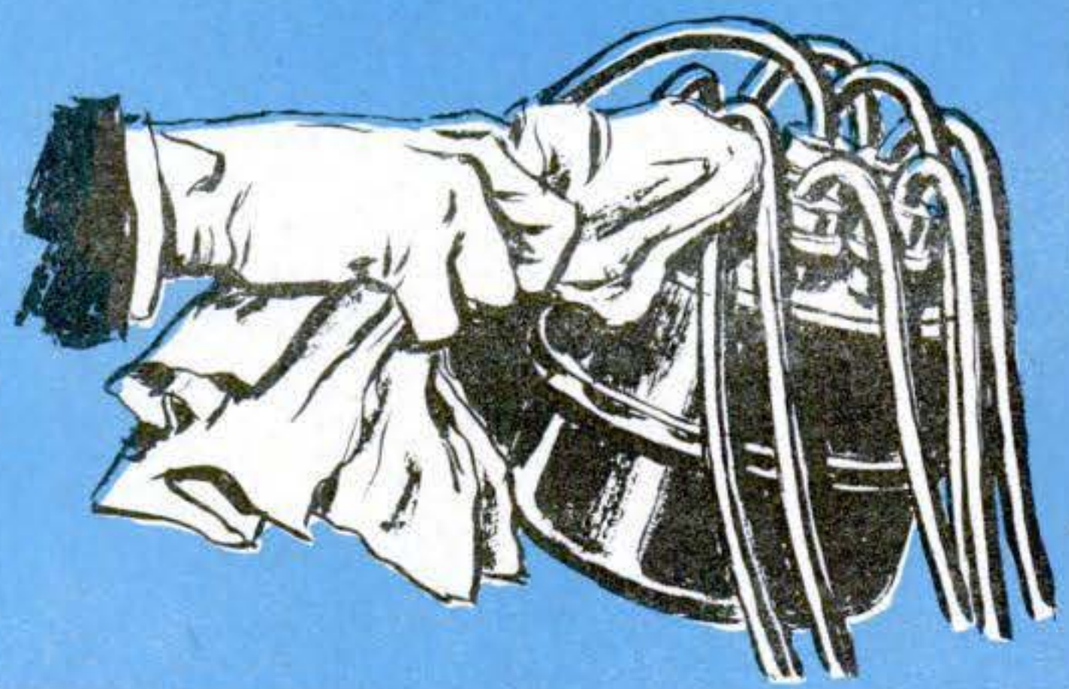
HERE'S A VARIATION of the jack-and-push trick used on sand. But instead of jacking up both wheels, just lift the one that's in the rut or ditch. Grease the path of the opposite wheel with the oil dipstick and push the car sideways off the jack and out of the rut.



ANOTHER SOLUTION where the jack comes into play is raising the offending wheel and placing the spare over the rut to act as a runway.

Getting started in deep water

YOU'RE DRIVING through a flooded stretch of road and the water turns out to be deeper than you had expected. Suddenly your engine coughs and dies. What should you do? First turn off the ignition switch. Then roll up your trouser cuffs and dry off the ignition with a rag. Wires leading from the distributor cap to the spark plugs are the prime offenders. After getting the engine started, drive out *slowly*.



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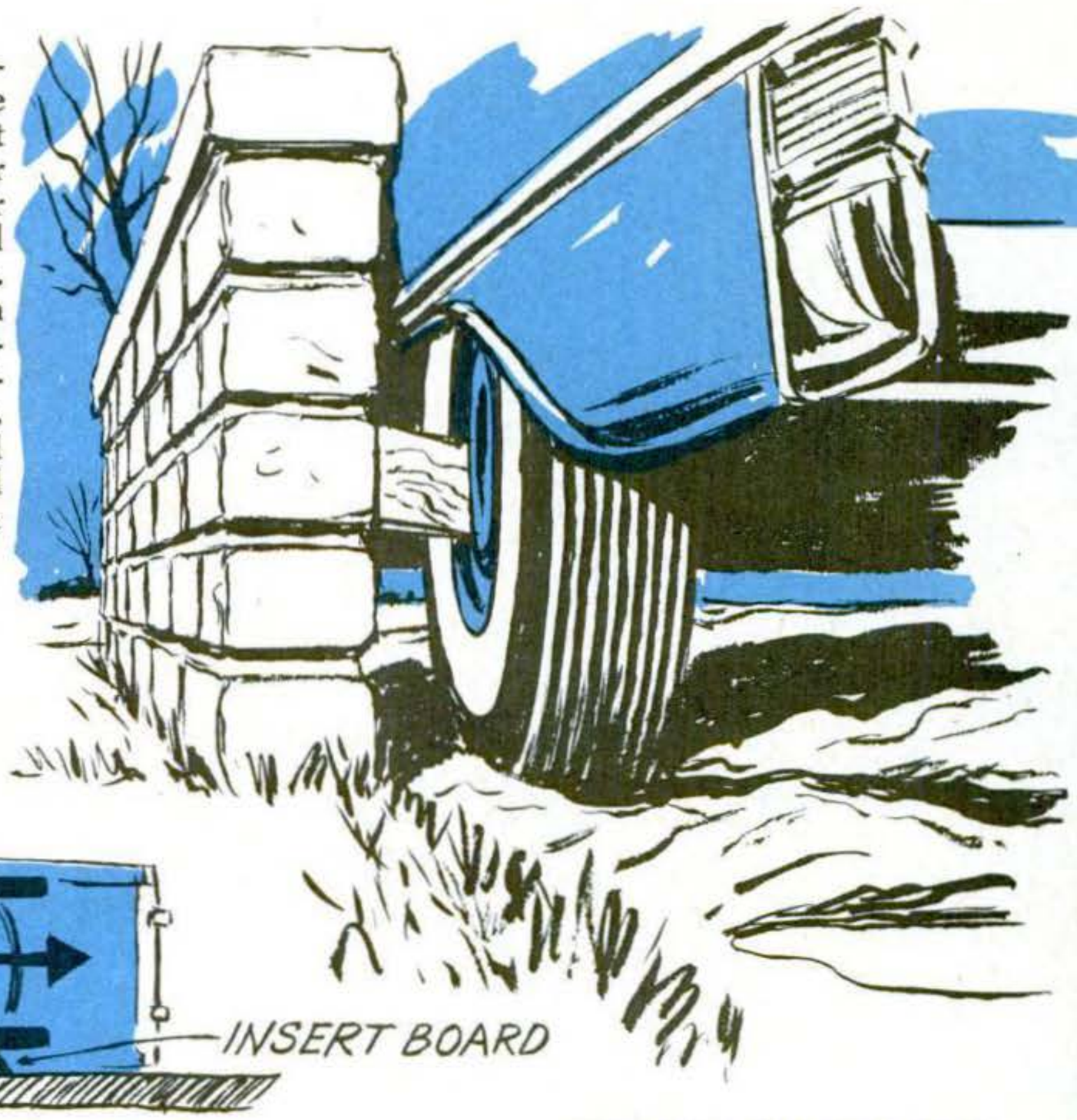
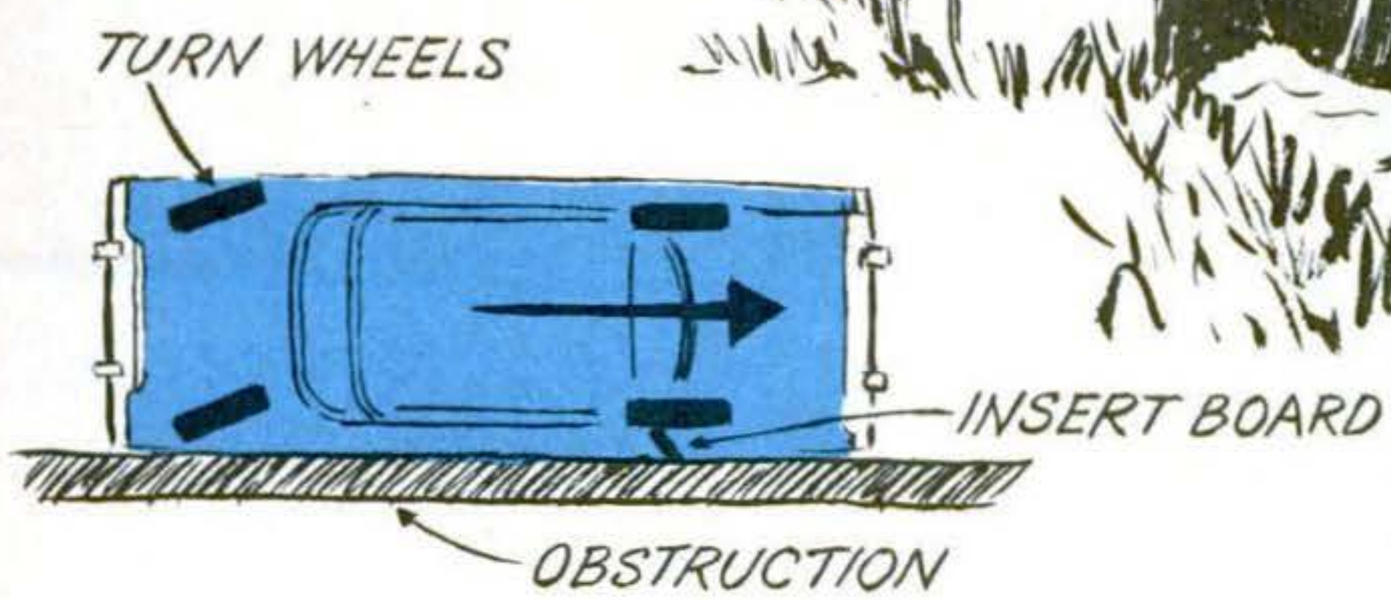
Prying it away from a wall

IF THE ROAD IS CLEAR, and a tree or other solid object is across from the wall either in front or in back of the car, run a rope tautly from the object to your car's bumper. If the anchor is to the rear of your car, cut the wheels slightly away from the obstruction and drive forward. If the anchor is toward the front, back up with the front wheels cut toward the obstruction. The rope forms an arc that pulls the car away.

YOU'VE TAKEN A SKID, or misjudged distance, and now the side of your car is resting against a wall, snowbank, side rail, or other obstruction. Whichever way you drive, it seems, you'll scrape the entire side of the car. Remove the wheel cover from the rear wheel facing the obstruction. Then prop a two-by-four or pipe against a wheel lug. Cut the wheels slightly toward the obstruction and go backward slowly. The wedge will act as a lever to force your car away.





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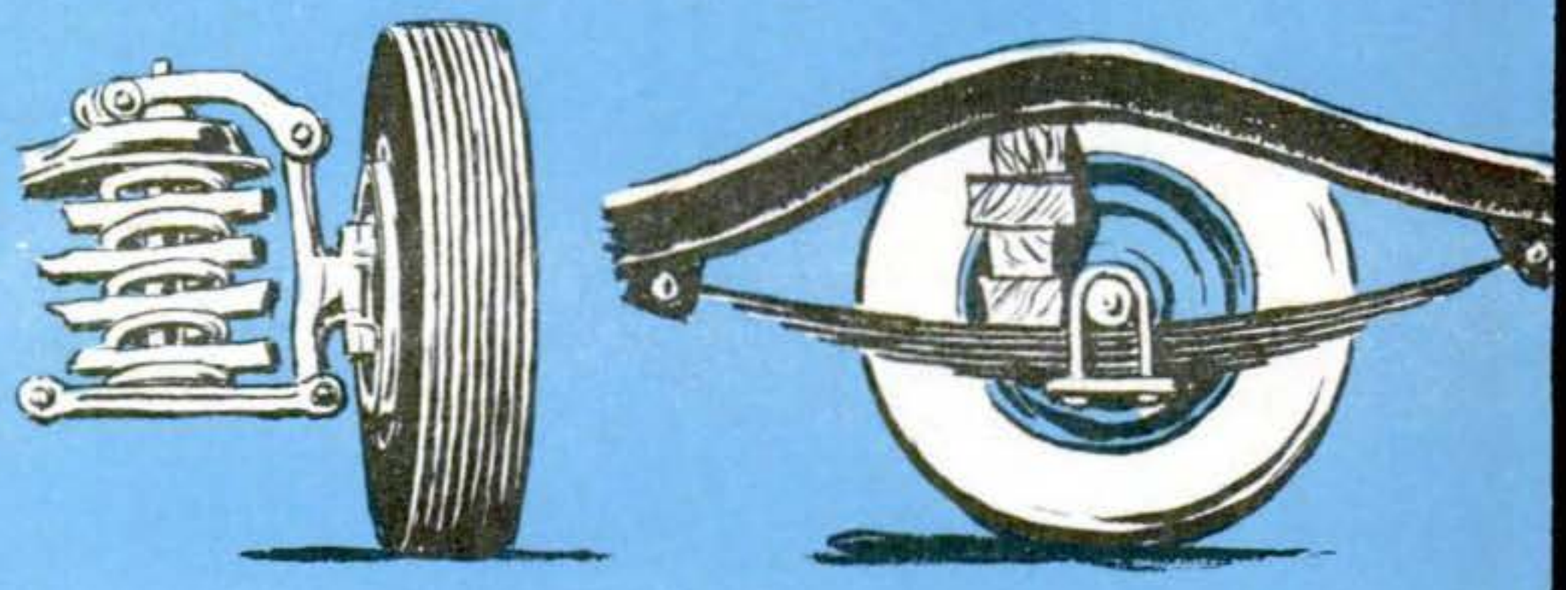
Freeing a hung-up car

THOSE LOW WALLS around many parking lots frequently snag rear bumpers. Or perhaps you backed onto a large rock. Unloading all passengers may help. Or try shifting them to the front seat.

IF YOU HAVE a trunkful of baggage and your rear end gets hung up, empty the trunk. Don't forget that heavy spare. Stationing the heaviest passenger on the front bumper should help raise the rear bumper still more.

UNDERCARRIAGE HUNG UP? Raising the body usually is the only solution. Jack up the car and insert wooden blocks as spring spacers. Large blocks can be slipped between leaf springs and axle; for coil springs, use smaller blocks inserted between the coils.



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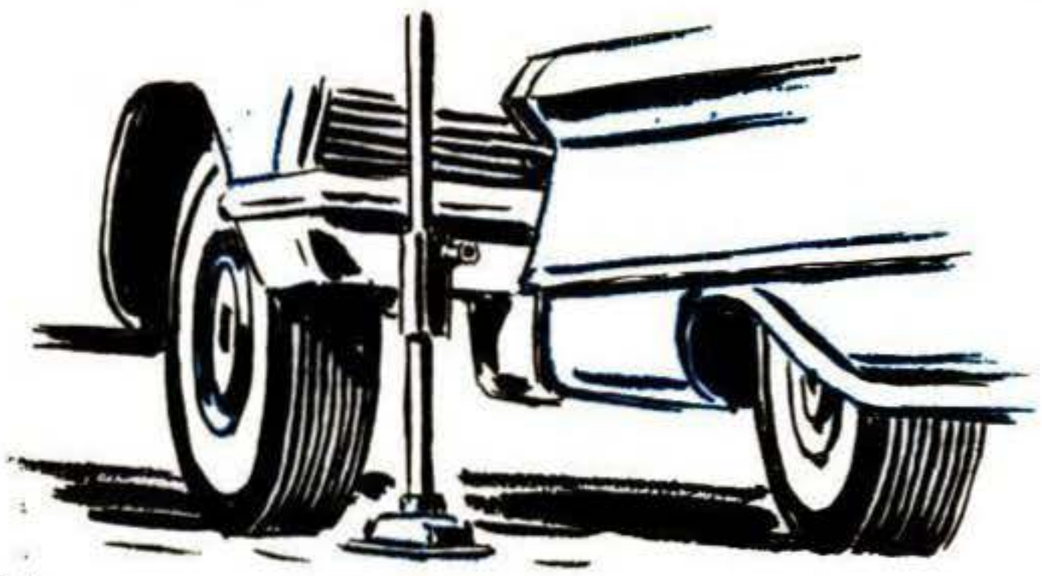
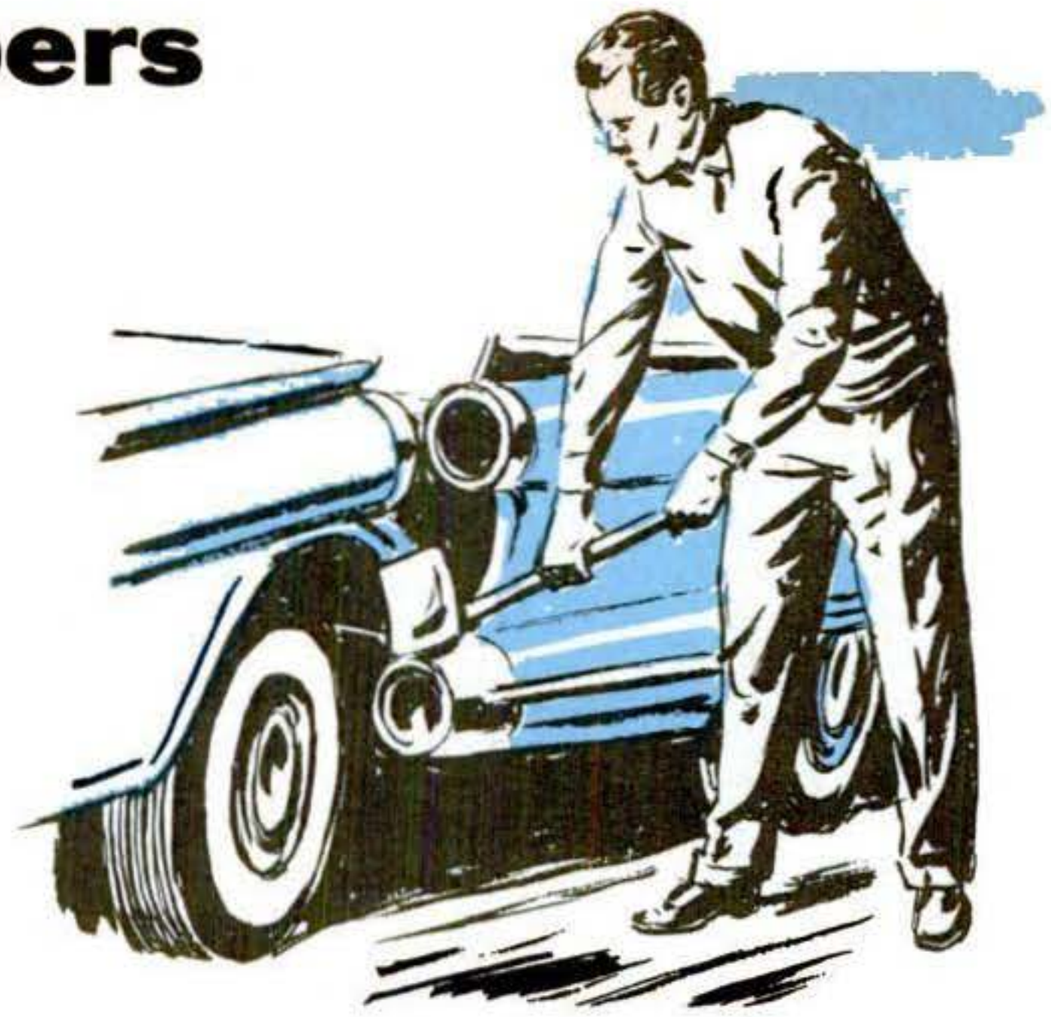
Unlocking bumpers

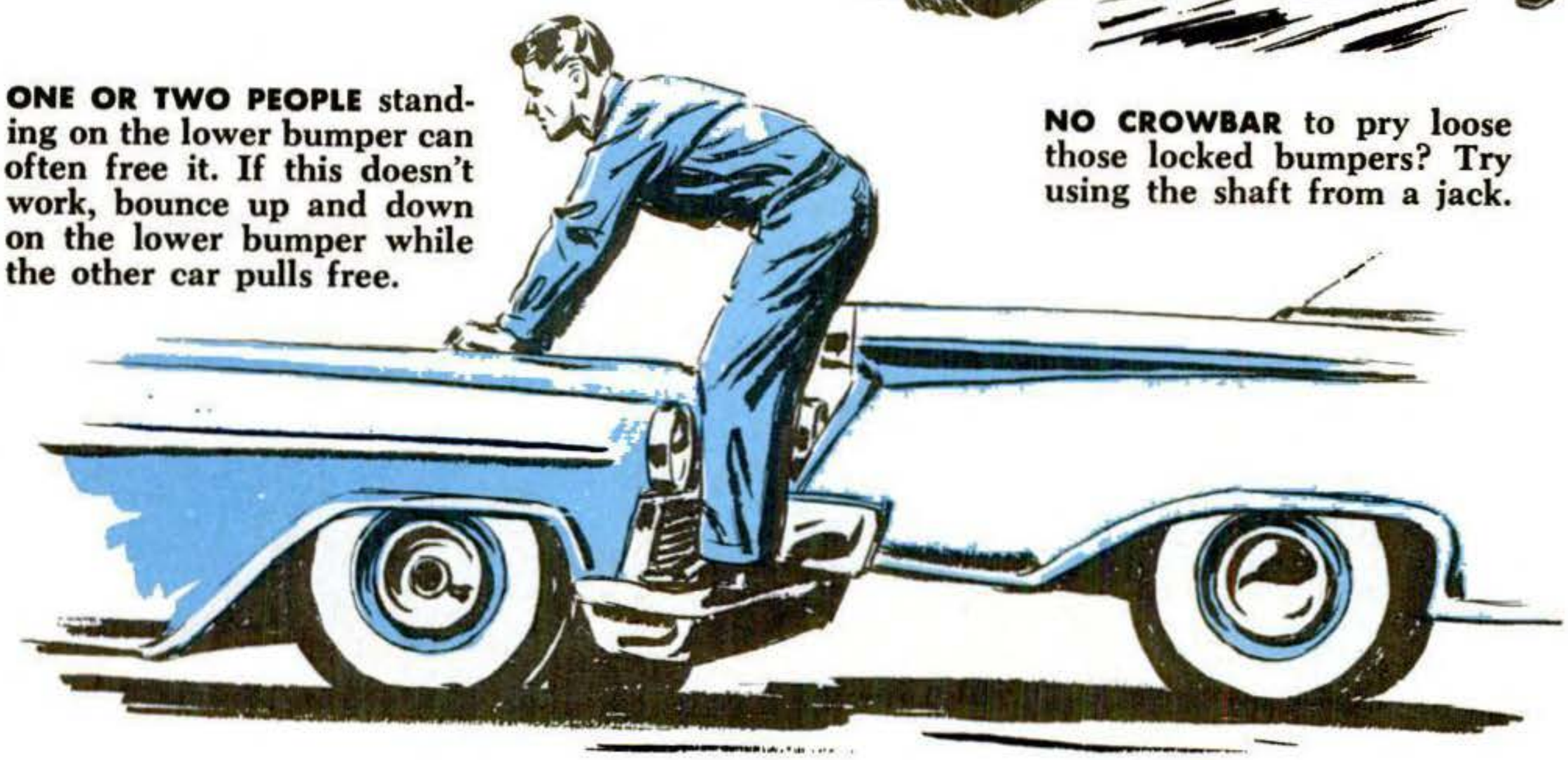


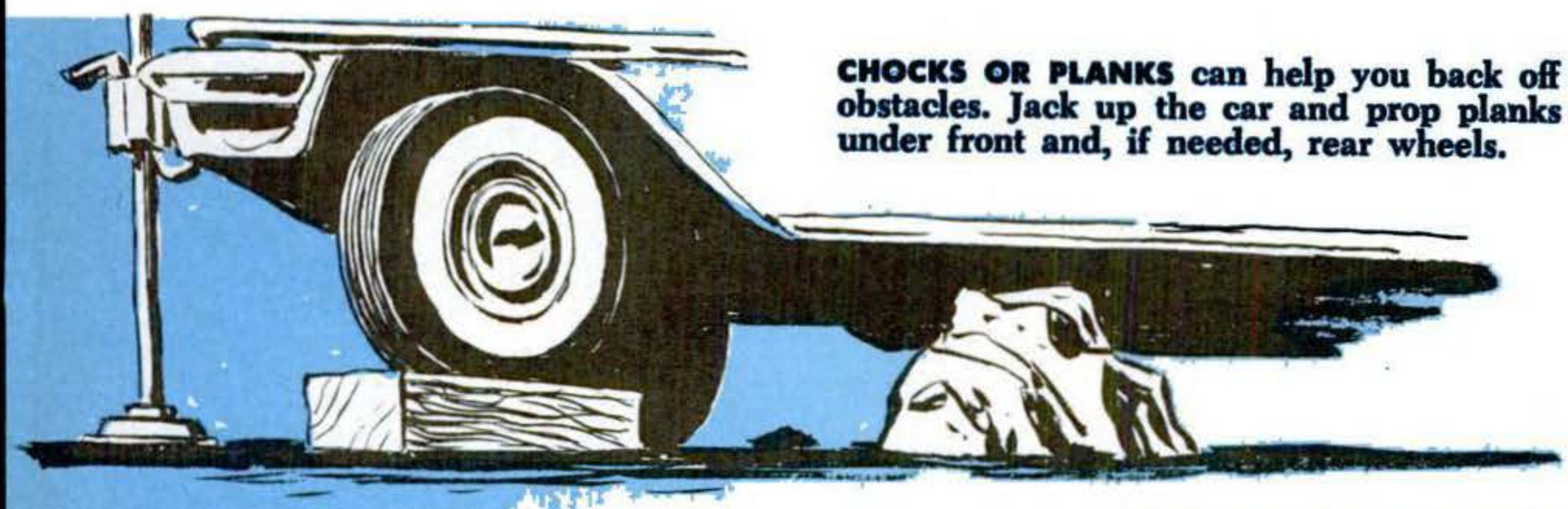


REMEMBER, YOU HAVE TWO JACKS (yours and the other car's) to work with. Raise both ends of upper bumper. Drive other car free.

ONE OR TWO PEOPLE standing on the lower bumper can often free it. If this doesn't work, bounce up and down on the lower bumper while the other car pulls free.

NO CROWBAR to pry loose those locked bumpers? Try using the shaft from a jack.





CHOCKS OR PLANKS can help you back off obstacles. Jack up the car and prop planks under front and, if needed, rear wheels.

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P. S. EXTRA: YOUR TEAR-OUT BOOKLET NO. 18

To remove this booklet, place your left hand on the facing magazine page, grasp the booklet with your right, and pull it gently away.

After reading, store it in the glove compartment of your car, where it can give valuable help in time of need.

December 1960
POPULAR SCIENCE

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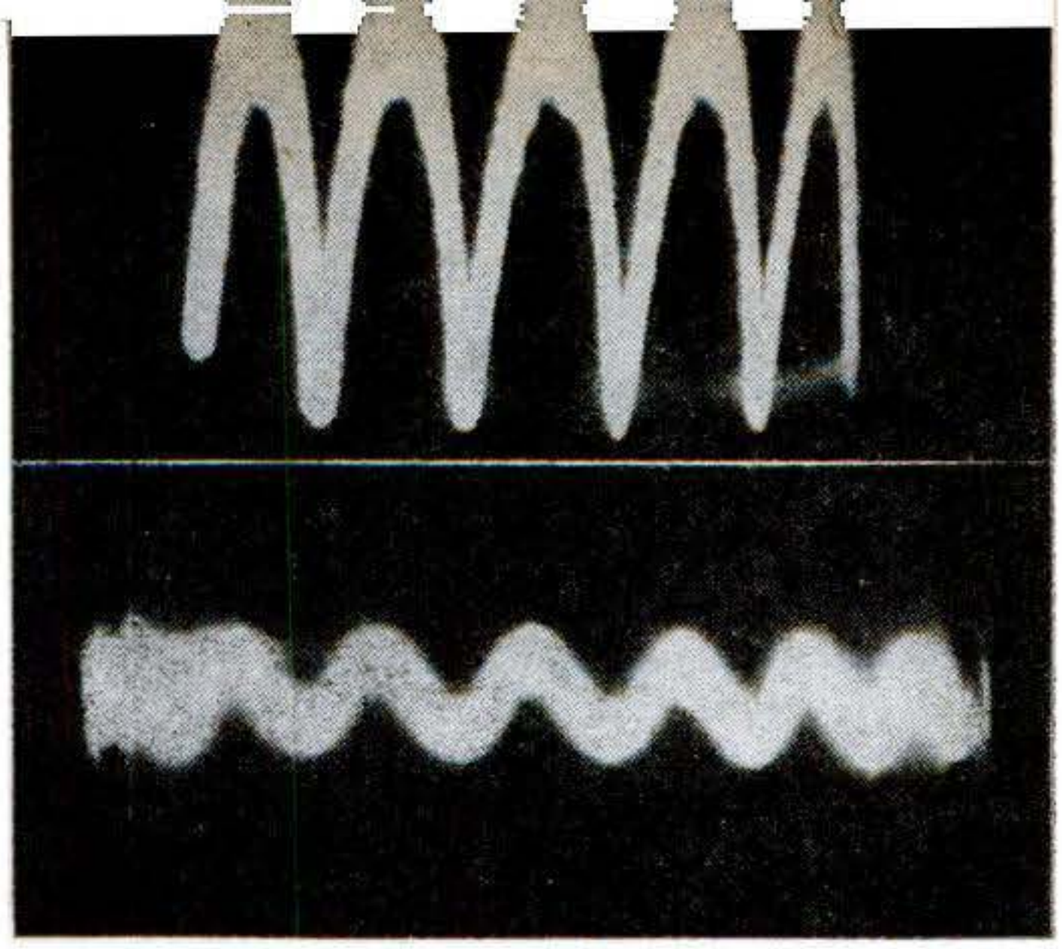
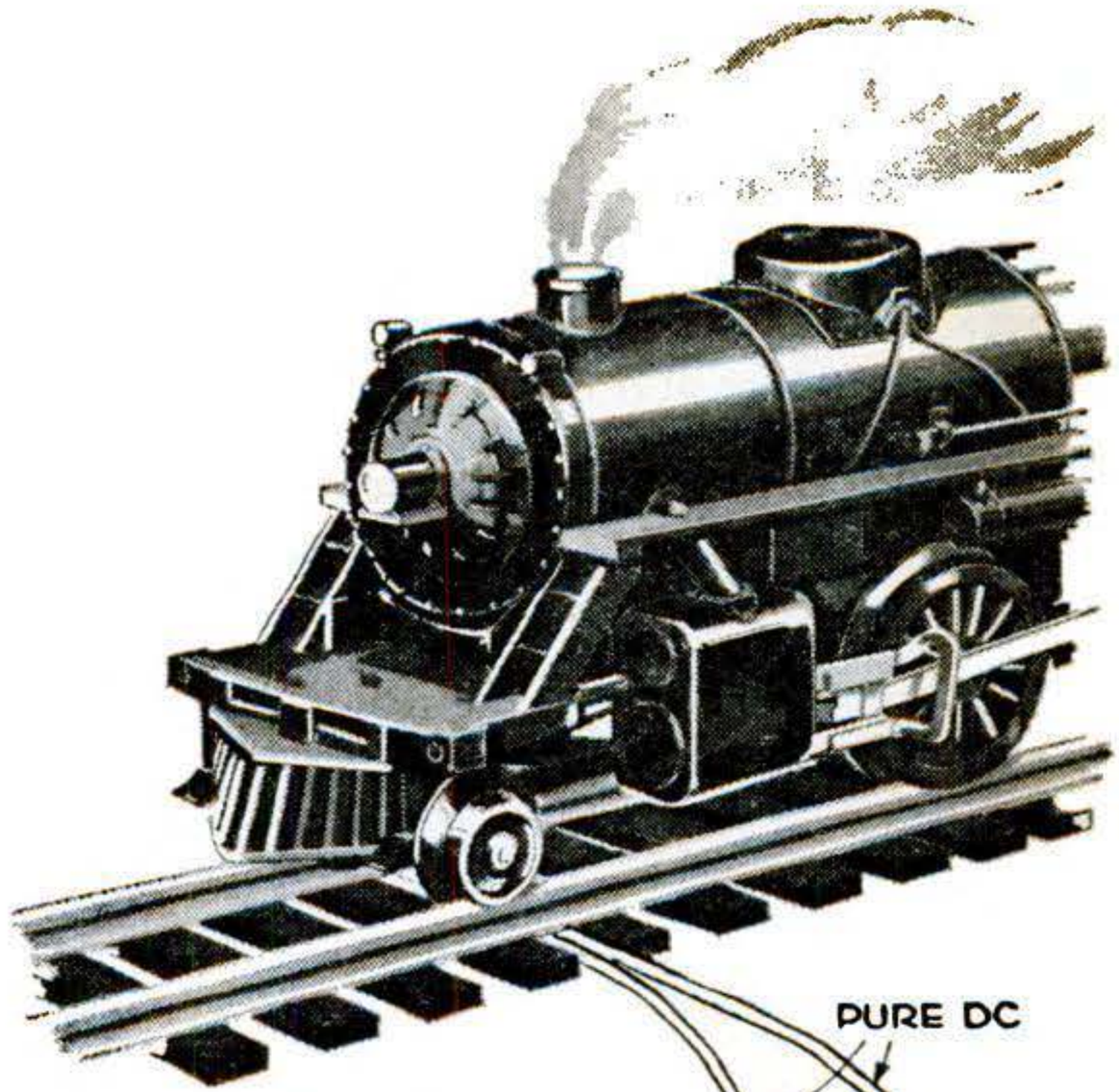
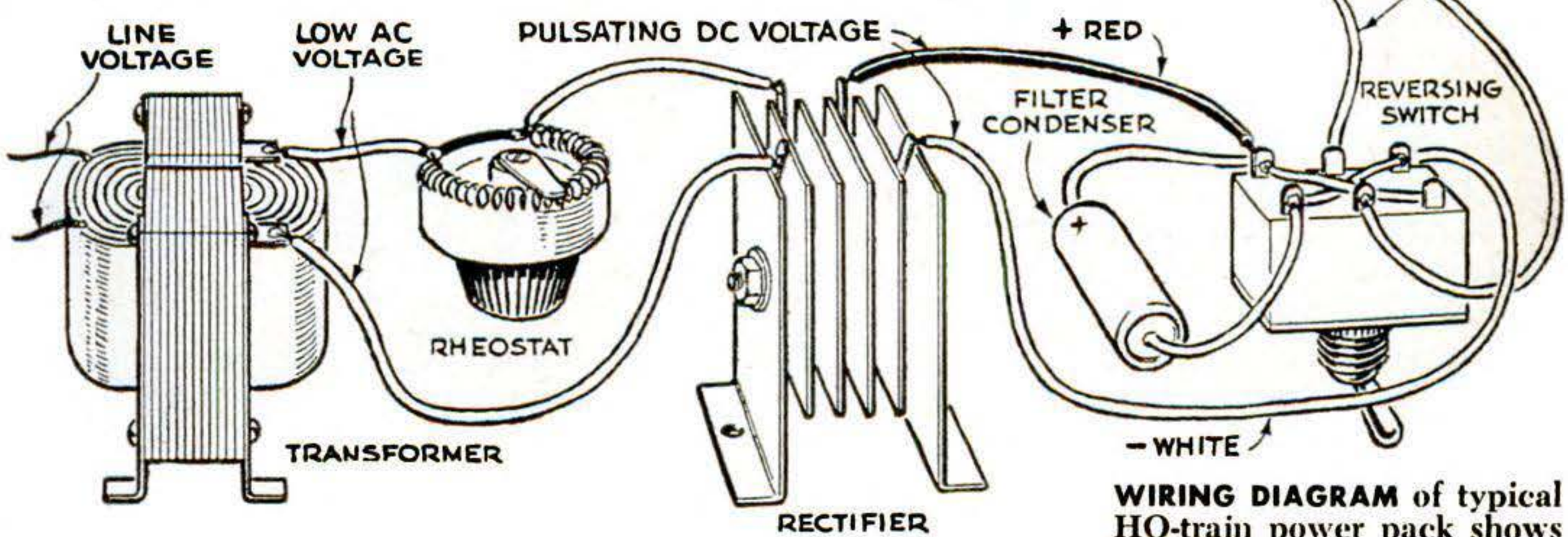


OSCILLOSCOPE PATTERNS show (at top) pulsating power-pack output before installing filter and, in lower pattern, how filter reduces pulse peaks, producing a more nearly constant voltage.





WIRING DIAGRAM of typical HO-train power pack shows how AC house voltage flows through transformer, rheostat, and rectifier, and comes out as low-voltage DC. To install filter condenser, simply solder its two leads as indicated, taking care to maintain correct polarity.

Making Model Trains Run Better

INSTALL a $2 filter condenser in the power pack and you'll greatly improve operation of a model railroad.

The tiny motors in HO locomotives are designed to run on DC current—the purer the better. Yet the typical transformer-rectifier power pack supplies pulsating DC. Though satisfactory, the pulsating voltage makes the motors run hotter and causes locomotives to be sensitive to poor track connections and dead spots at turnouts and crossovers. The condenser eliminates these nuisances, reduces sparking at the brushes, and—a bonus—reduces TV interference when trains are operated. It's certainly $2 well spent.

The hookup is simple. Connect the positive lead of the condenser to the positive input lug of the reversing switch —usually the lug connected to the red wire coming from the rectifier. Solder the negative lead to the lug that is connected to the white or negative rectifier wire. If the wires are not color-coded, take the power pack to your radio or TV repairman. He can check the polarity for you at little or no charge.

The condenser, a 500-microfarad, 25-volt, electrolytic filter, may have insulated or bare leads. If bare, slip a length of "spaghetti" insulating tubing over them to prevent accidental shorting.—*John E. Flippen, Steubenville, Ohio*

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New Tools from Old Files

You can't buy most of these tools—but you can make your own from discarded files

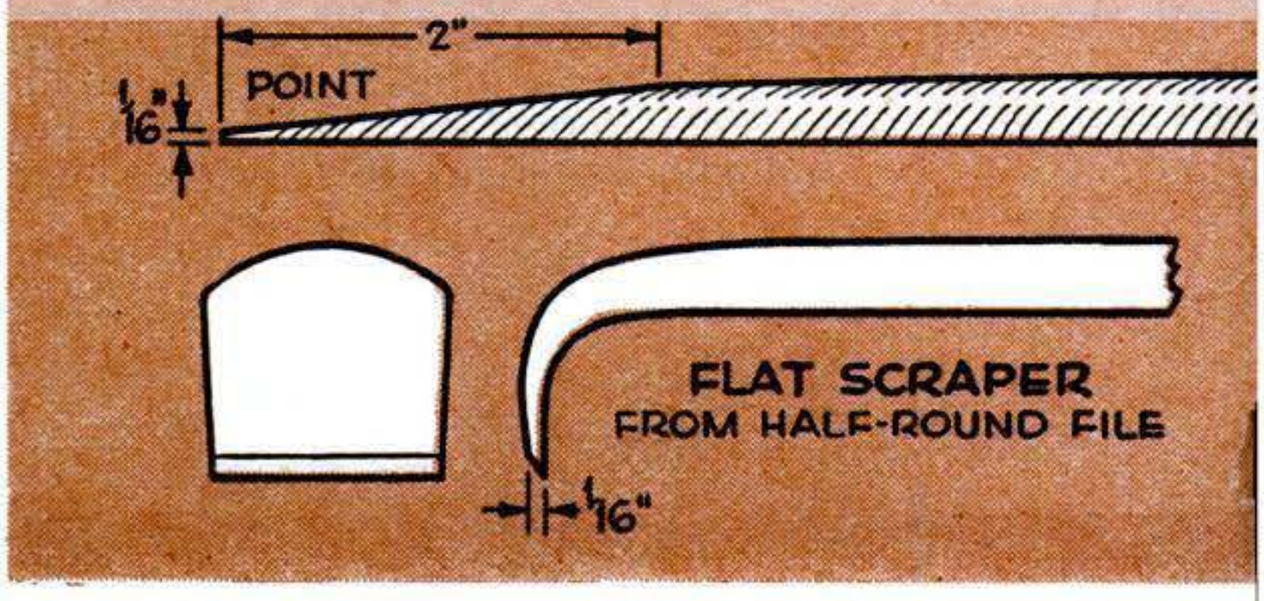
By Walter E. Burton

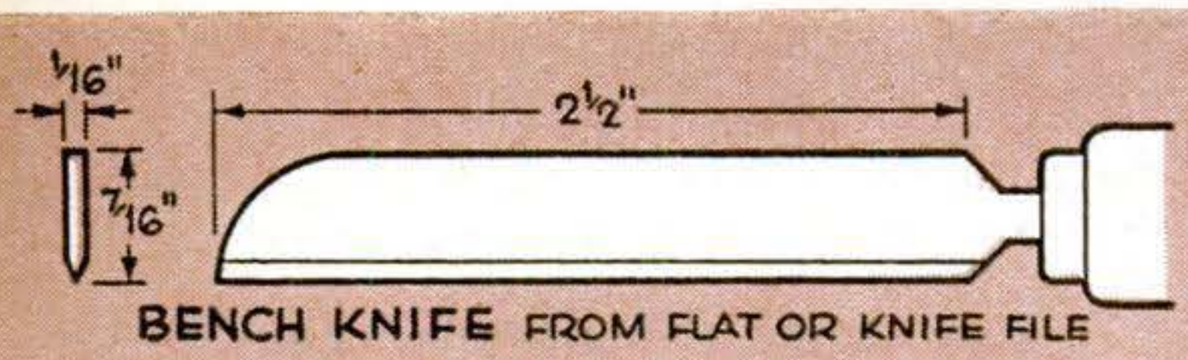
YOU can't retooth worn-out files, but you can salvage their high-carbon steel by converting them into a variety of special-purpose tools. Files come in many shapes and sizes that can be ground, filed, and bent into useful new forms. You may even be intrigued enough by one or two of these custom-made tools to make them from new files.

Some of the tools don't even require you to soften (anneal) the steel for reworking. Where the conversion involves only grinding or soldering, use light pressure on a cool-cutting wheel and assemble with soft solder so that excessive heat won't reduce the file's original hardness. As long as the steel doesn't change color, it will need only a final tempering to render it less brittle.

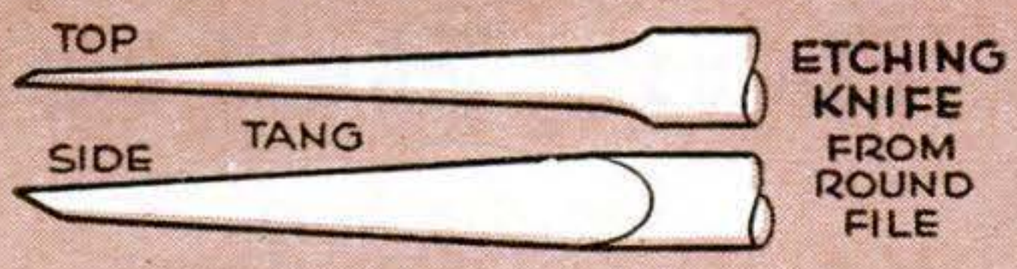
If the work requires annealing, you'll have to reharden the steel. All heating can be done with a propane torch. For the thicker files, direct the flame into an oven formed of three or more firebricks.

FOR SCRAPERS, half-round files are best. Grind away all teeth and taper point end as shown. Heat this part red and bend about an inch at right angles to the flat back in an easy curve.

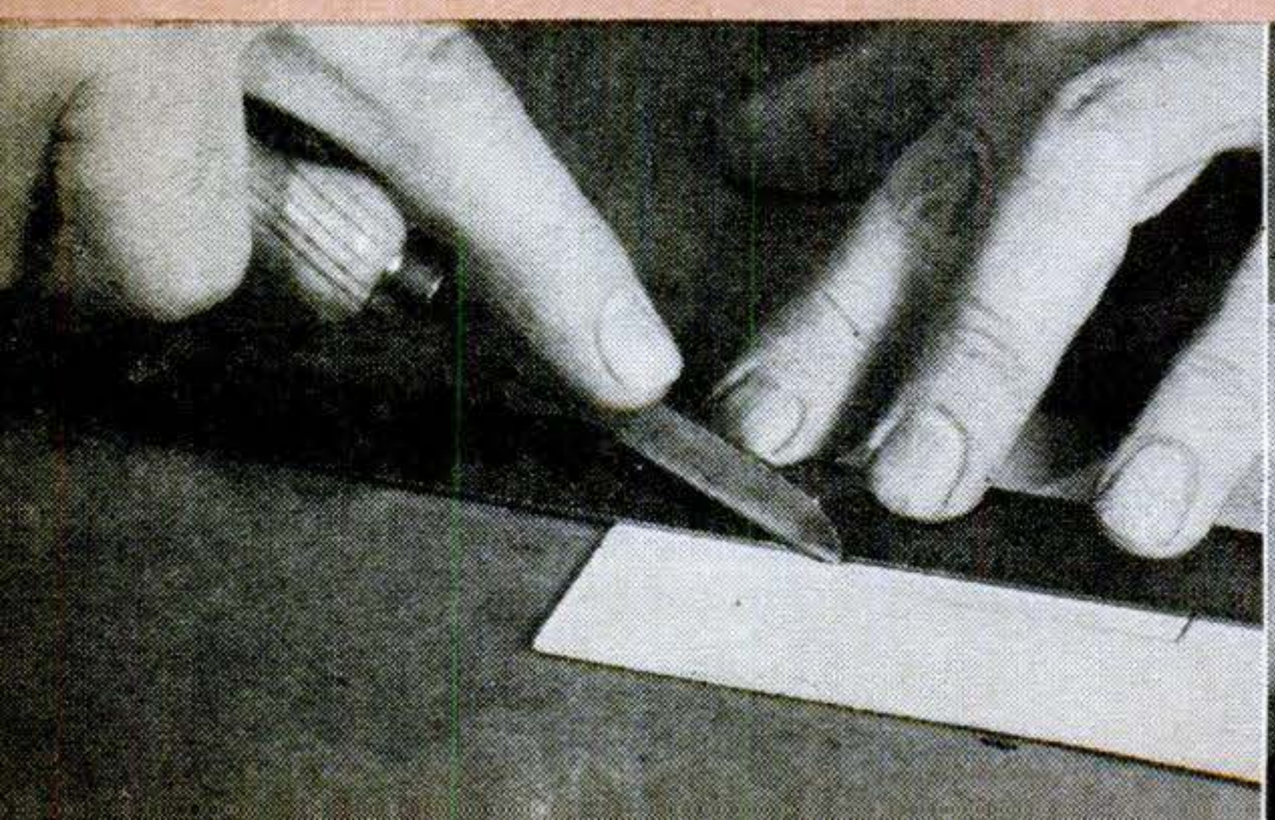


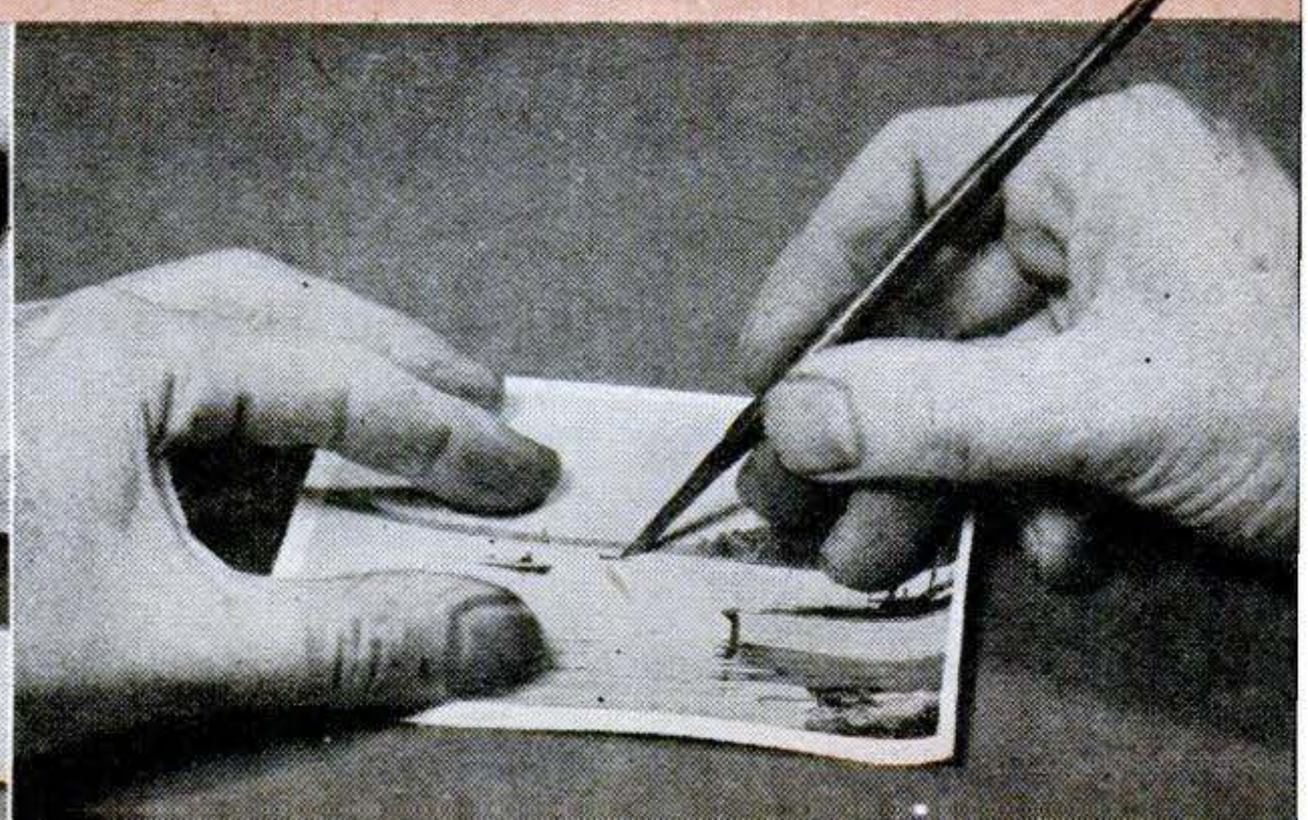


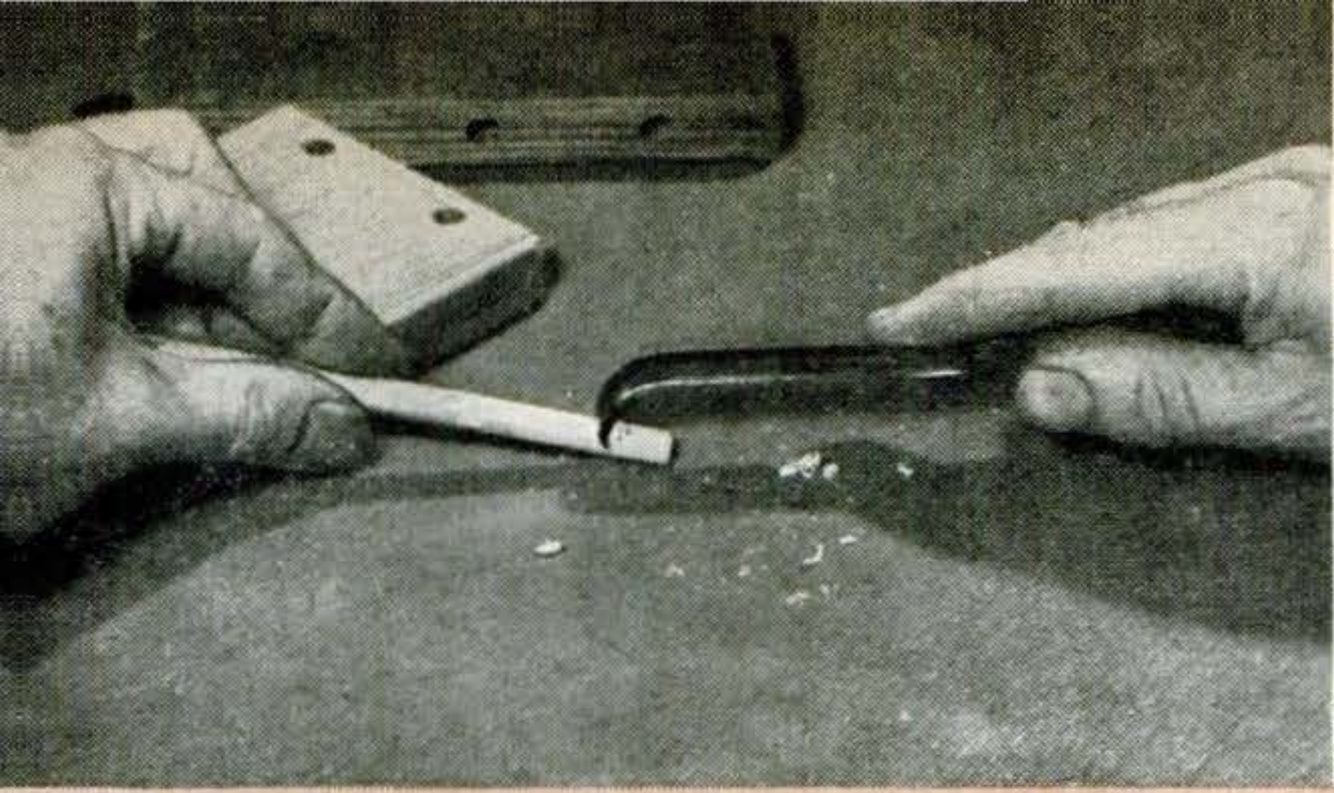
BENCH KNIFE for cutting templates and other shop chores is made by grinding teeth off a file about the size of the desired blade. Shape the tip and double-bevel the cutting edge for heavy-duty work, where the back of the blade will be tapped with a mallet. Polish the blade with abrasive cloth before and after tempering, and hone the cutting edge sharp on an oilstone.

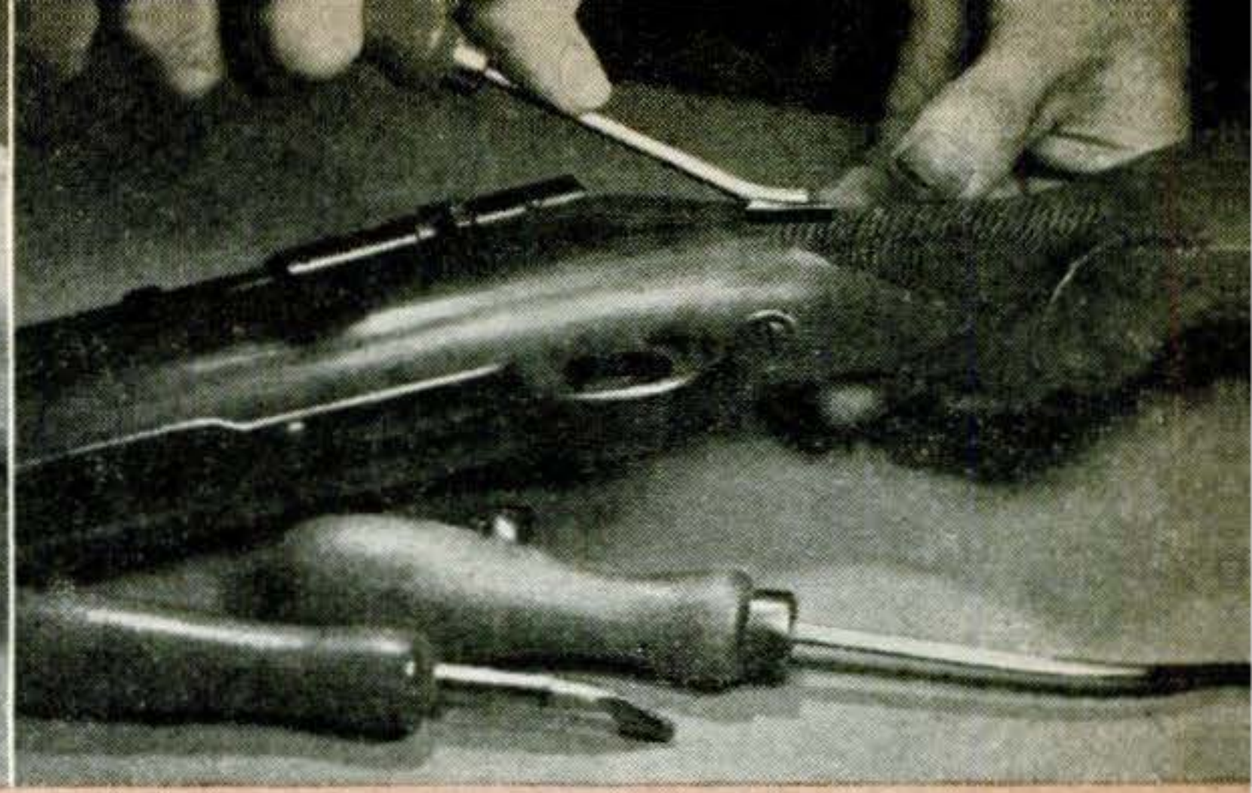


AN ETCHING TOOL for retouching photo negatives and removing dark spots from prints can be made by putting a chisel edge on the tang of a round (rat-tail) file or rasp. Since this part of the file is unhardened, it's easy to shape. Similar tools can be made for fine touch-up of plastic or wood carving. Grind the teeth dull to provide a comfortable handle grip. Heat and quench tang.

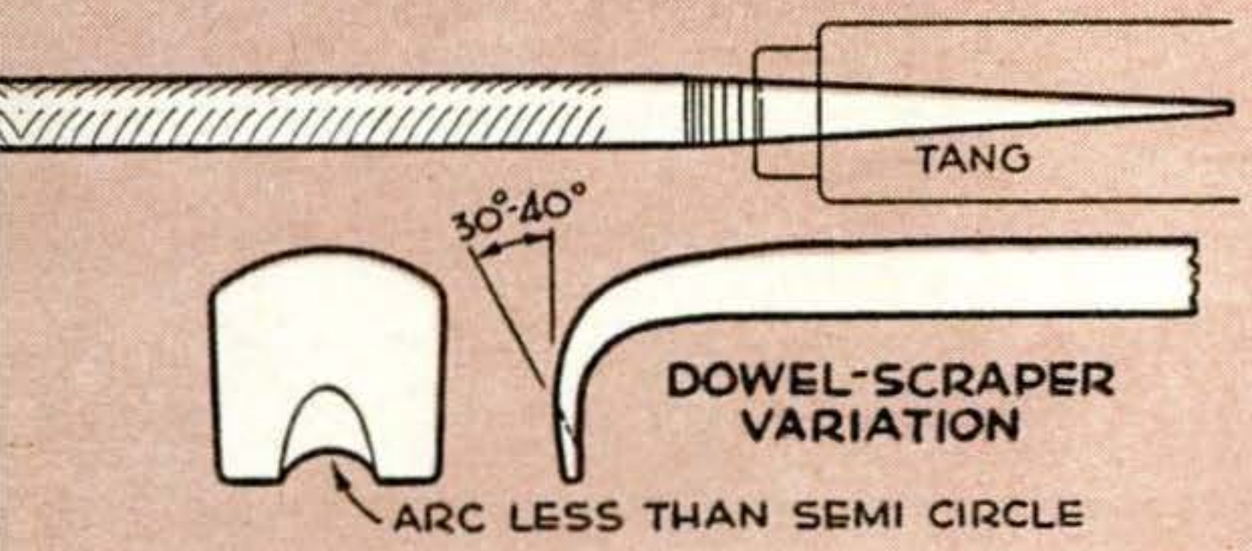




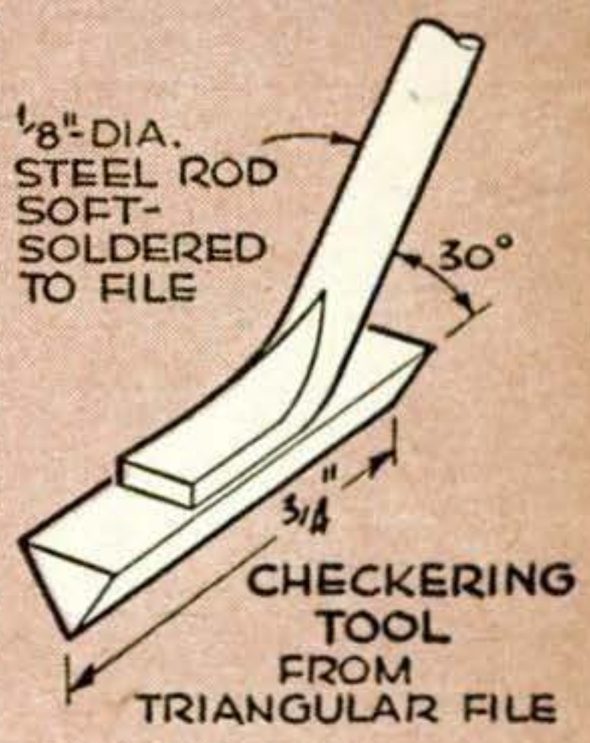




Reharden and bevel outside of tip to sharp edge. Variation is scraper for trimming oversize dowels. Less-than-half-round notch is filed in edge and can be resharpened with a round stone.

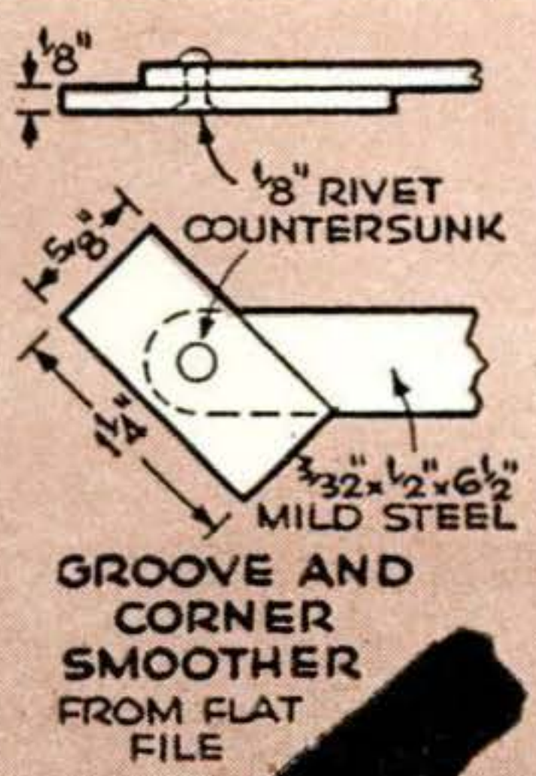


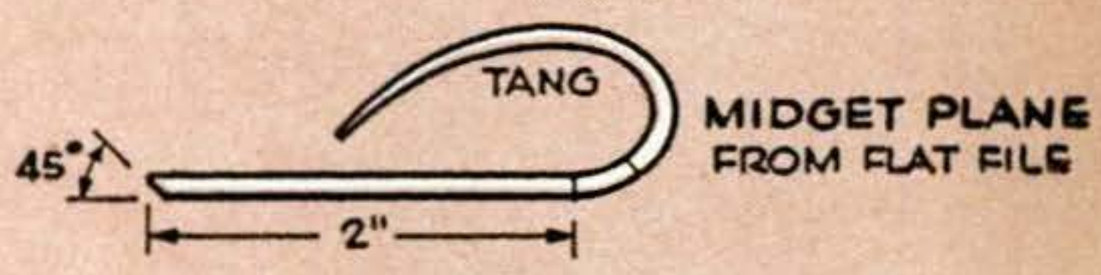
GUN-STOCK CHECKERING (crisscrossed V-shaped grooves) can be cut with a triangular file. Conventional checkering tools (foreground) cut several parallel grooves at once, but good single-groove version is made by soldering piece of file to the flattened end of a steel rod. Grind teeth off surface to be soldered. File shown has 3/16" faces.



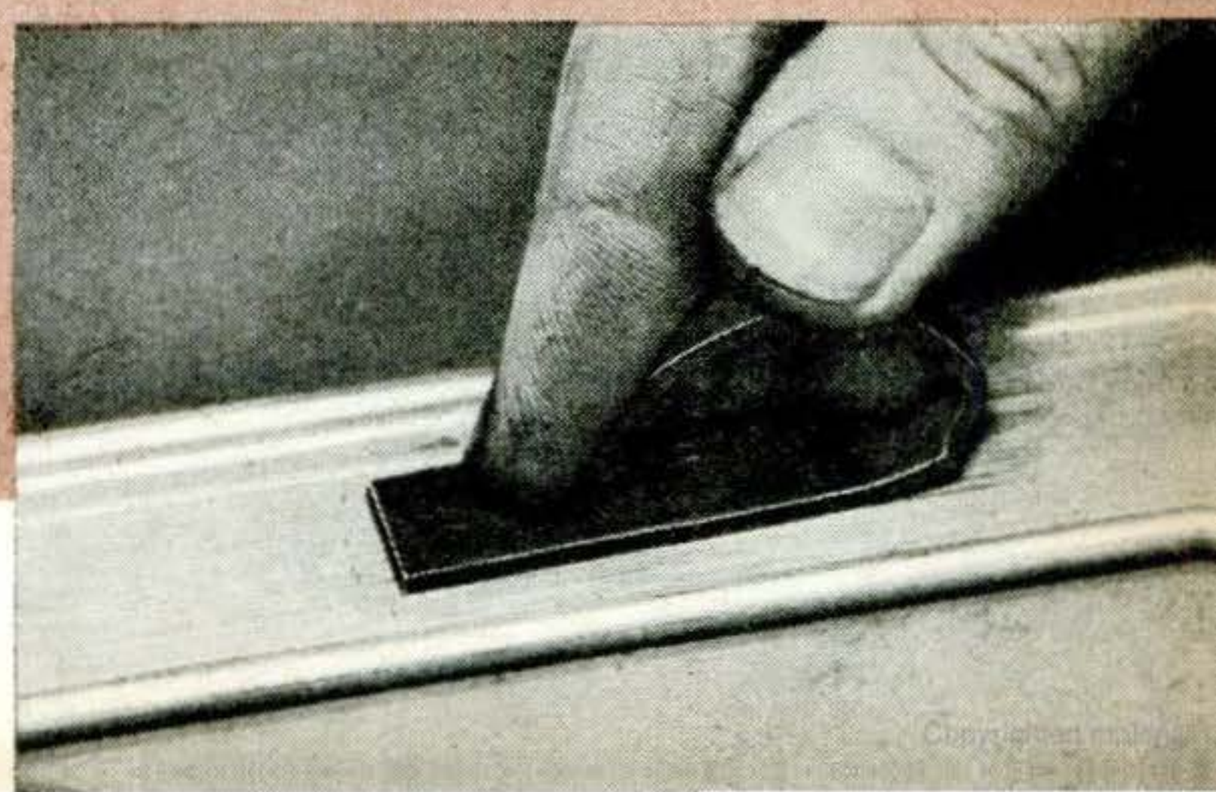
To temper the knife blade, heat until the steel turns medium yellow. Then either plunge it into cold water or let it cool at room temperature. Some craftsmen claim that slow cooling sets up less internal stress. The etching tool, groove-and-corner tool, and midget plane are hardened by heating the working parts bright red and plunging them into cold water. If the etching tool is to be used for cutting, however, the tang should also be tempered and honed, like the knife blade. The scraper blade can be left hard, but to avoid breakage it can be temper-heated to a light yellow. Other heating tips are given in the captions.

PIVOTING FILE: Section of file at end of handle strip forms a tool for smoothing grooves, inside corners, channels, and other hard-to-reach spots. Peen the rivet within a countersunk recess to permit use of this face of file. Anneal file by heating it red and letting it cool in the air. Cut out best section and file ends smooth. Wrap handle with electrician's tape.



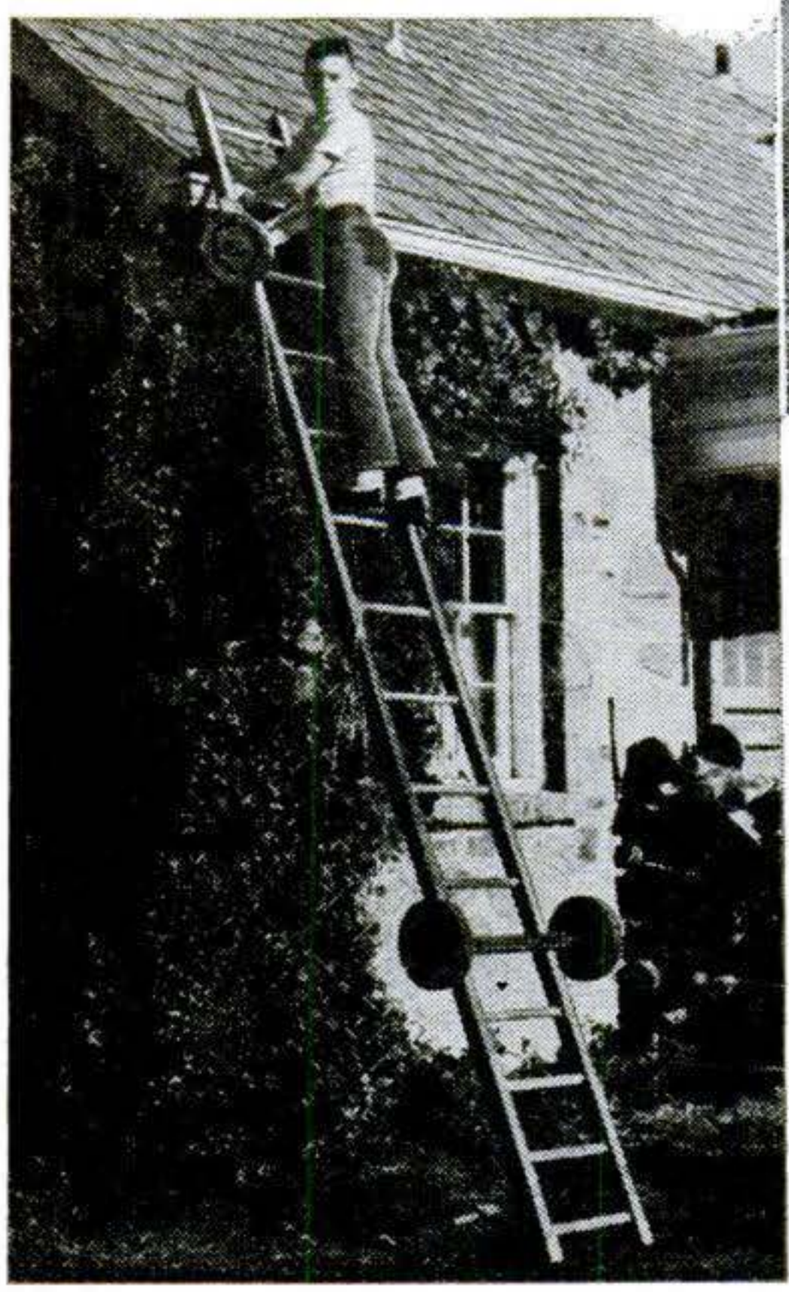


TINY PLANE for modelmaking and other delicate work is made by bending the tang of a file up to form a fingertip handle. Heat the tang and about 2" of the body until red. Curve the tang back over the face that's least usable and trim file to length shown. Bevel the bottom of the cut edge to permit smooth strokes and prevent gouging. Reharden the toothed portion. Smooth-cut files are best.



Short Cuts and Tips

FROM PS READERS



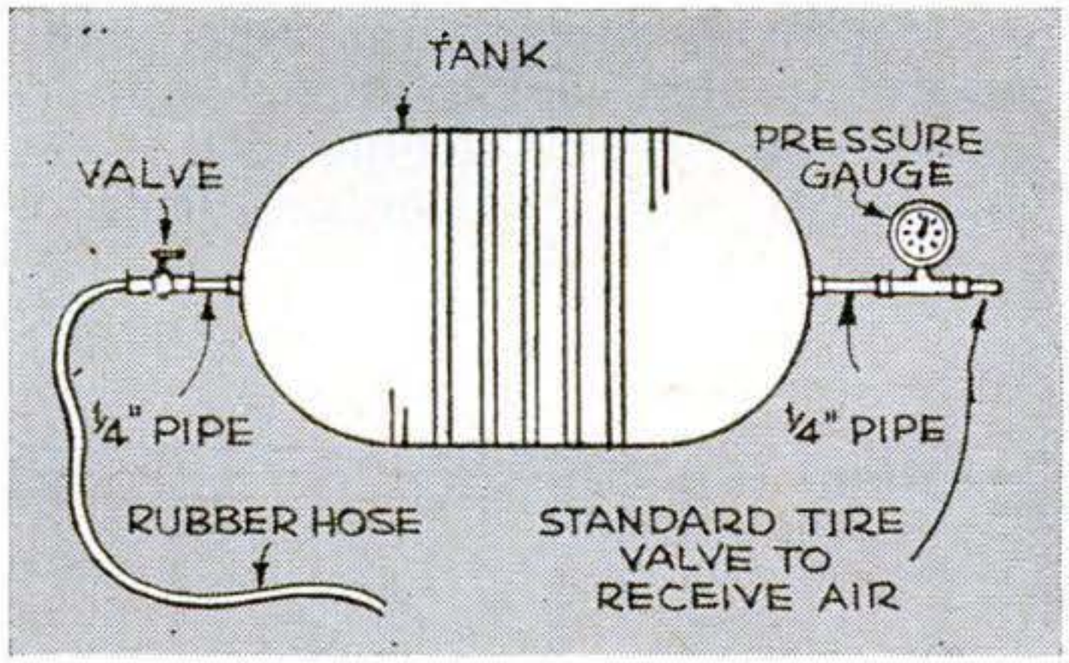
He Rides His Ladder to Work

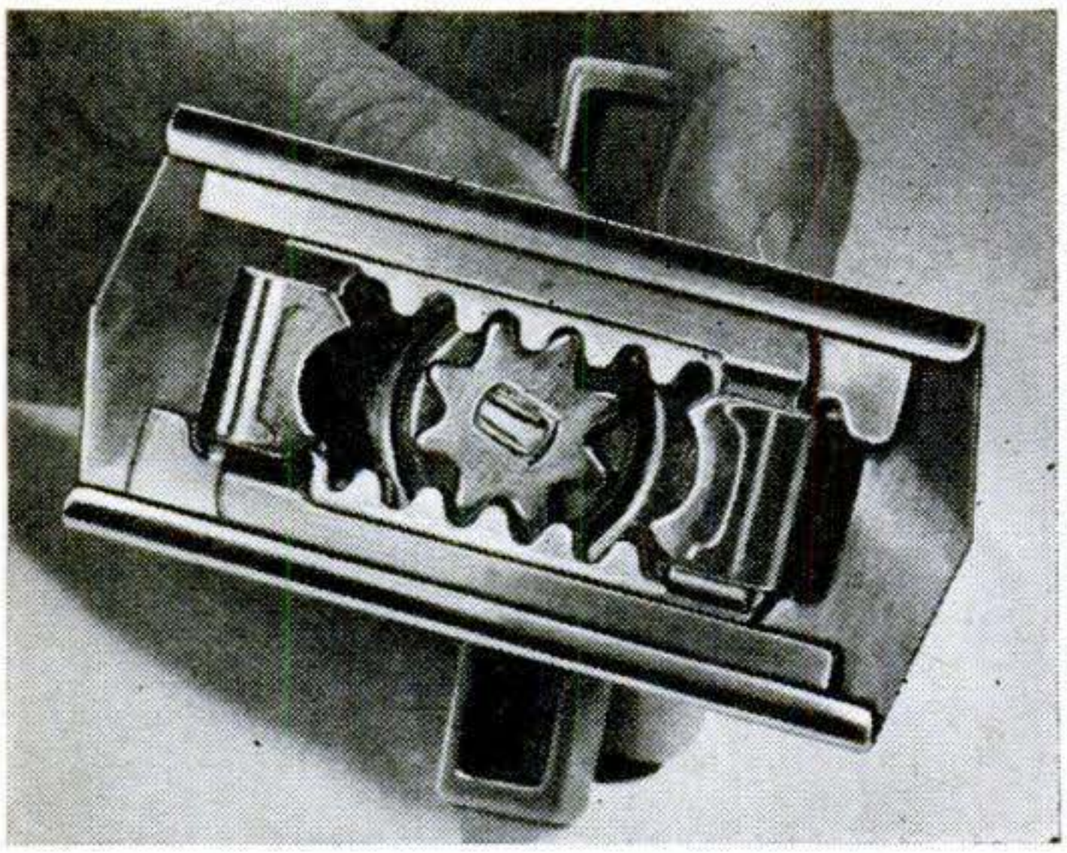
WHEN Eric Degroat lines up several Saturday jobs involving climbing—such as cleaning roof gutters—he scoots his mobile ladder across town without sweat and also loads his tools aboard. Off duty, the 13-year-old boy rides it for fun. The two axles are permanently attached; the rear one is fixed, the front one pivots for steering.—*John Corey, Boone, N. C.*

▶▶▶ASPHALT tiles can be heated for installation without the use of an open flame. I plug in a discarded sandwich grill and lay the tiles on it. If you borrow the one from the kitchen, protect the surface with aluminum foil.—*Harry Symes, Mt. Ephraim, N. J.*

Portable Compressed-Air Tank

EVER wish you could cart your compressor to a distant job? No need to—just tote a tank of compressed air. Fix up a surplus aircraft oxygen tank as shown and fill it to 100-lb. pressure. Remove the filling hose, and the tank is ready for such work as inflating tires on the road and blowing out clogged oil lines and drain pipes.—*Donovan Lathrop, Saguaro National Monument, Ariz.*





What's it for?

HAVE you ever seen this tool? The handle works the gear between opposing racks. Turned one way, it draws the jaws at the ends of the racks together. Turned the other way, it separates them. There is no spring, ratchet, or lock to hold the jaws in position, yet they do their job more efficiently than other devices for the same purpose.

Do you know what that job is? Think a moment; then check your guess against the answer on page 201.

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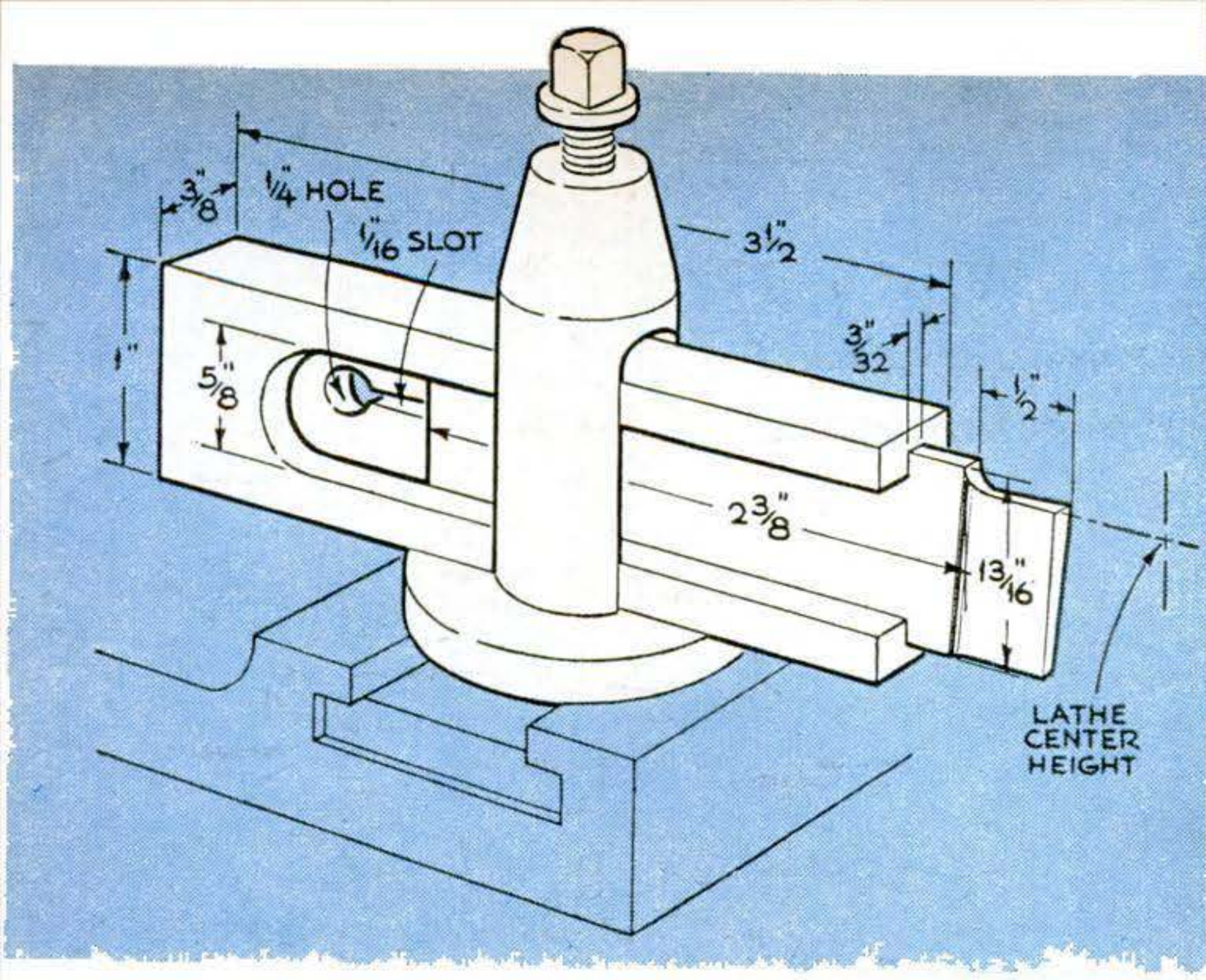
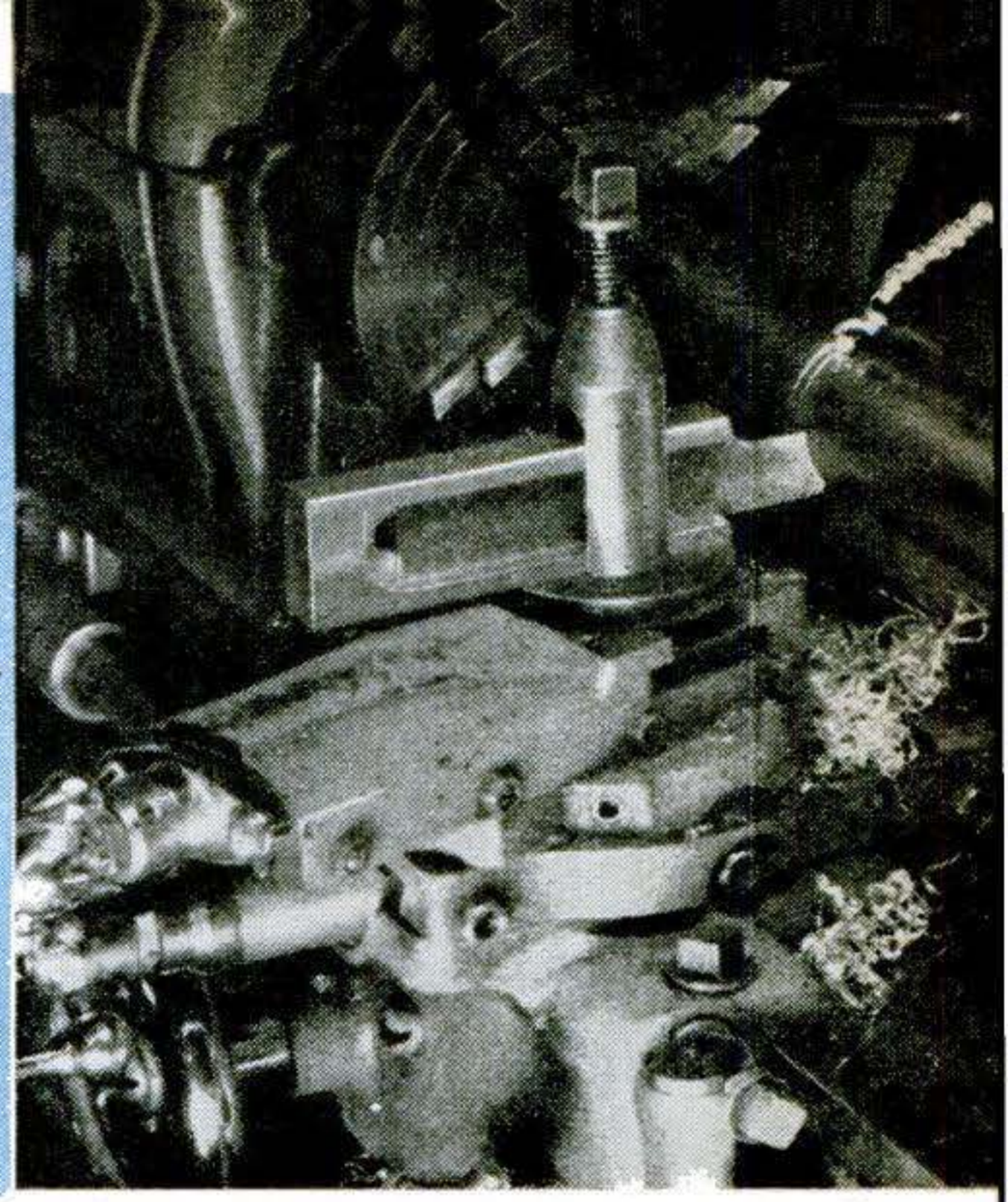




Making a smooth, trouble-free cut-off

HOW TO MAKE A Chatterless Cut-Off Tool

IF YOU dread the cutting-off operation on a small bench lathe, here's a tool that will banish most of your troubles with chattering, hanging, or broken bits.

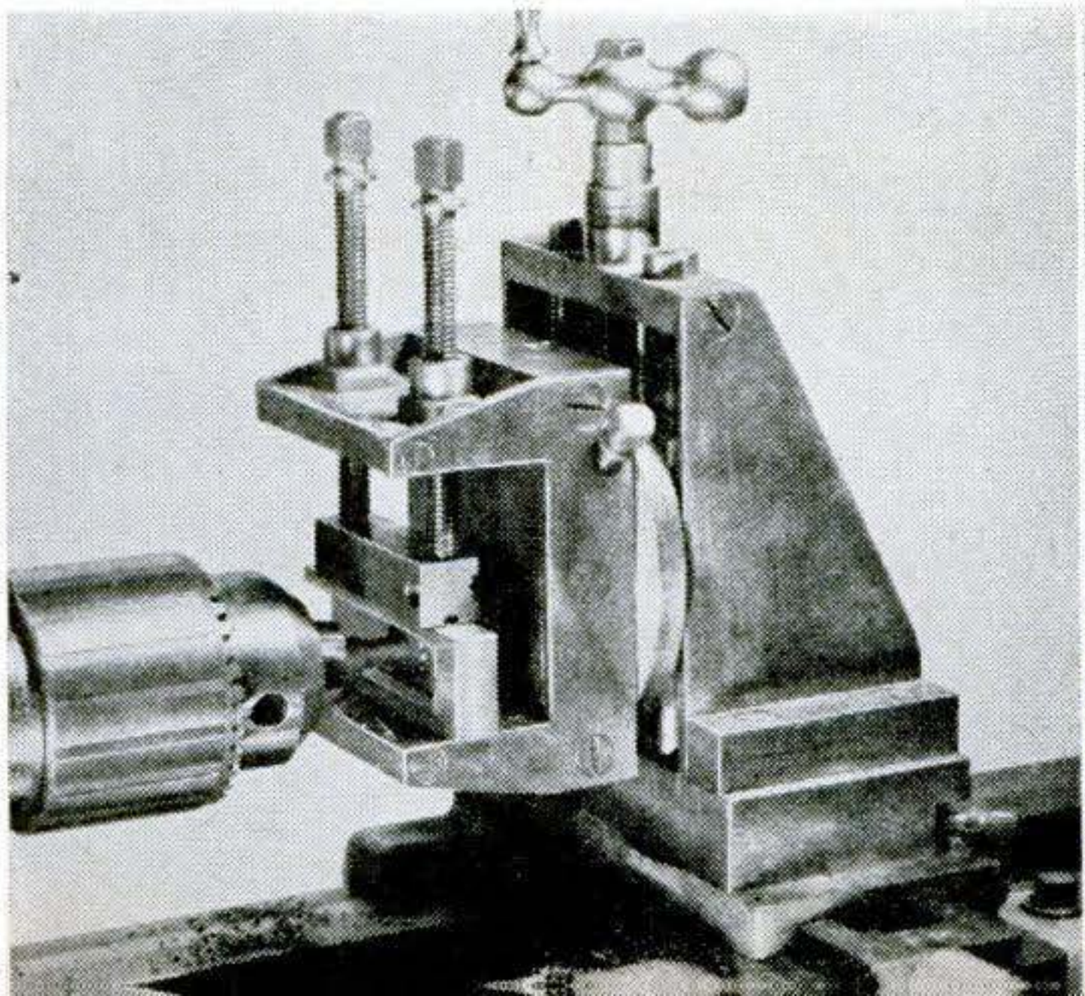
I made the one shown for my 6″ lathe from a piece of 1″-by-3/8″-by-3 1/2″ cold-rolled steel. You can easily adapt the dimensions to suit a different machine.

Mill out the side of the blade-holder-to-be with an end mill or keyway cutter. Cut the grooves for the blade with a small slitting saw. Make two or more passes to get the width required for a close fit on the blade you will use. Next, drill the 1/4″ hole before disturbing the setup. Then clamp the workpiece flat and slit with a 1/16″ slitting saw.

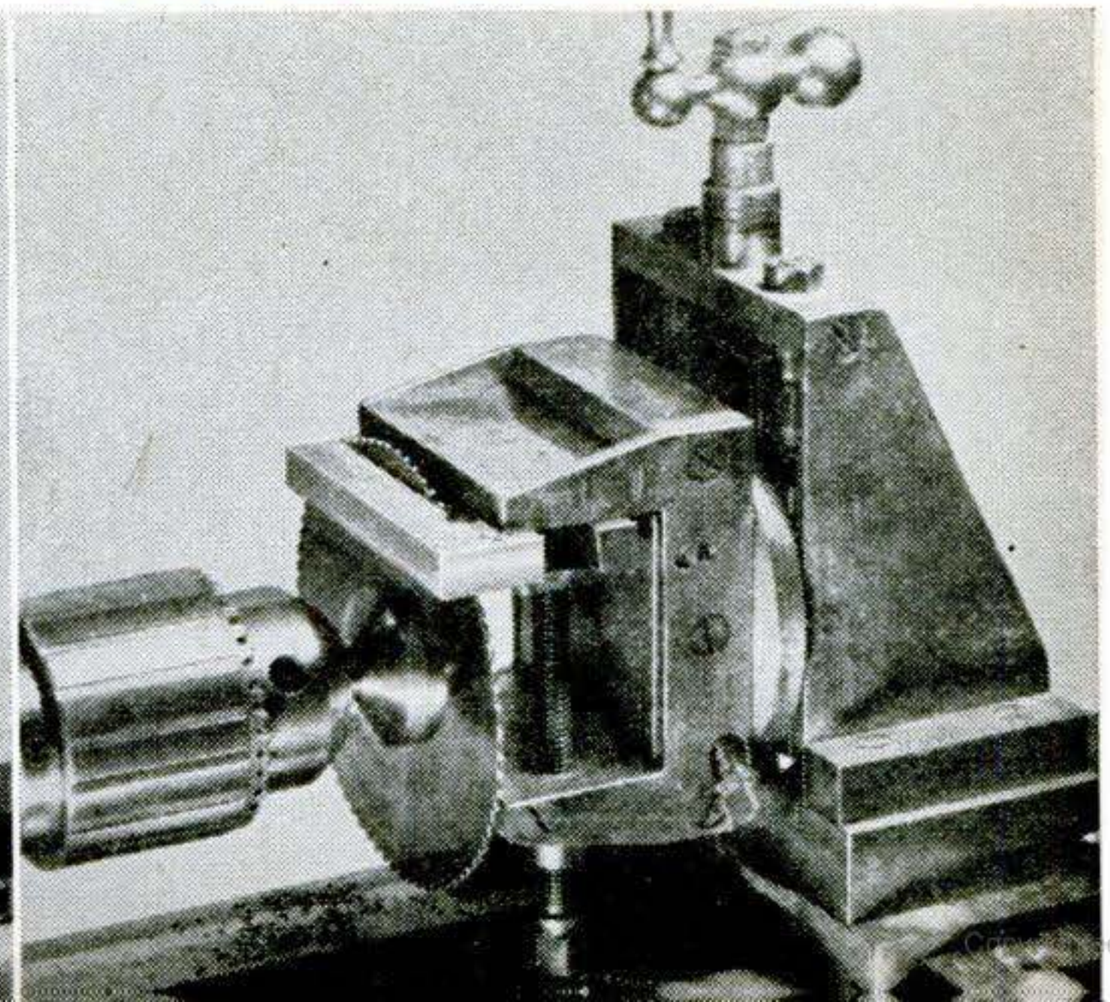
The blade itself can be a standard commercial product or you can make a very good one from a discarded power-hacksaw blade. Be careful not to burn the metal when you grind the teeth off. The top and bottom edges of either blade should be ground to a nice sliding fit in the holder.

Finally, mark and grind the cutting edge. Remove the tool-post crescent and turn over the concave ring (flat side up). Clamp the holder with blade in tool post and mark the top of the cutting edge from the tailstock center. Remove and grind the top of the blade down until the cutting edge is at exact center height.
—*Gordon Douglas, Stayner, Ont.*

Mill grooves to fit the cut-off blade

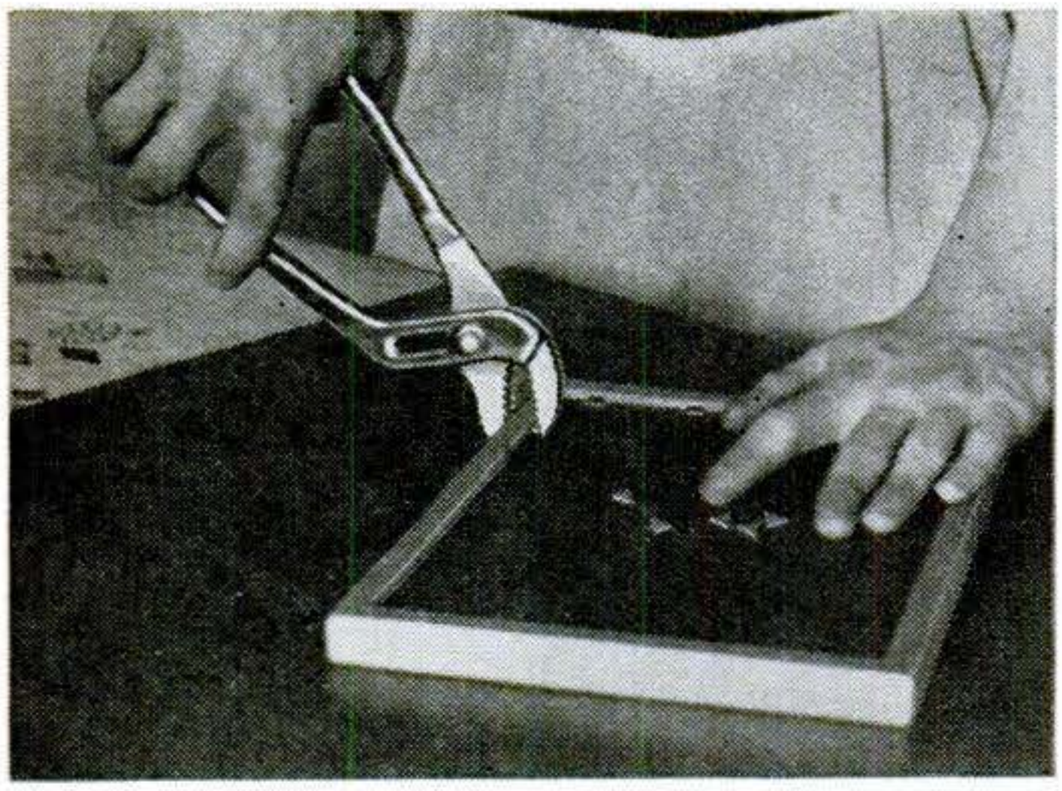


Slit from the far end back to the 1/4″ hole



Short Cuts and Tips

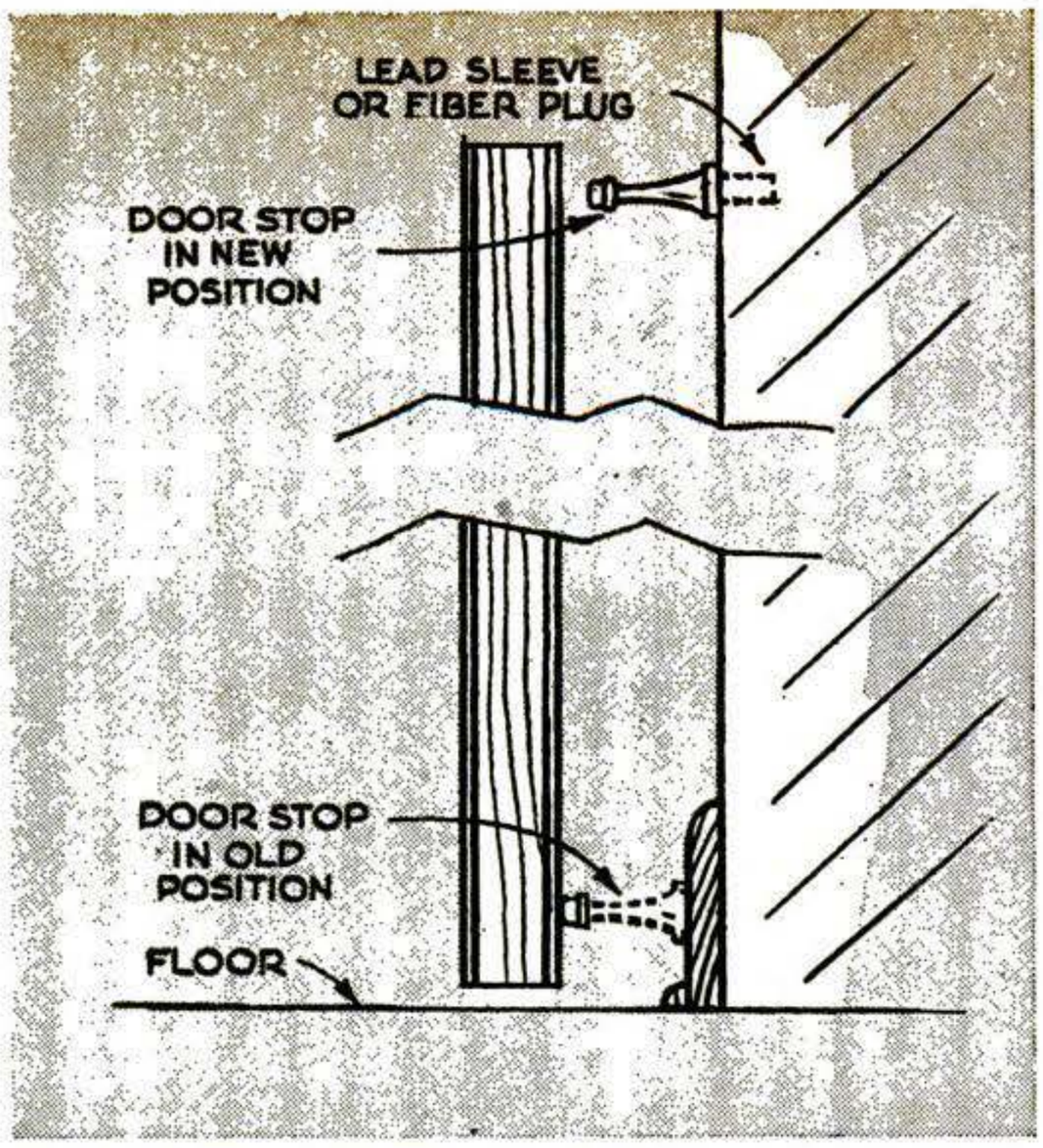
FROM PS READERS



Driving Points with Pliers

GLAZIER'S triangular points are ideal for holding a picture in a narrow frame, but tapping them in with a hammer often loosens the miters. Avoid this by driving each point in place with a squeeze of your pliers. A cardboard pad protects the finish.—*Michael Ligocki, Gary, Ind.*

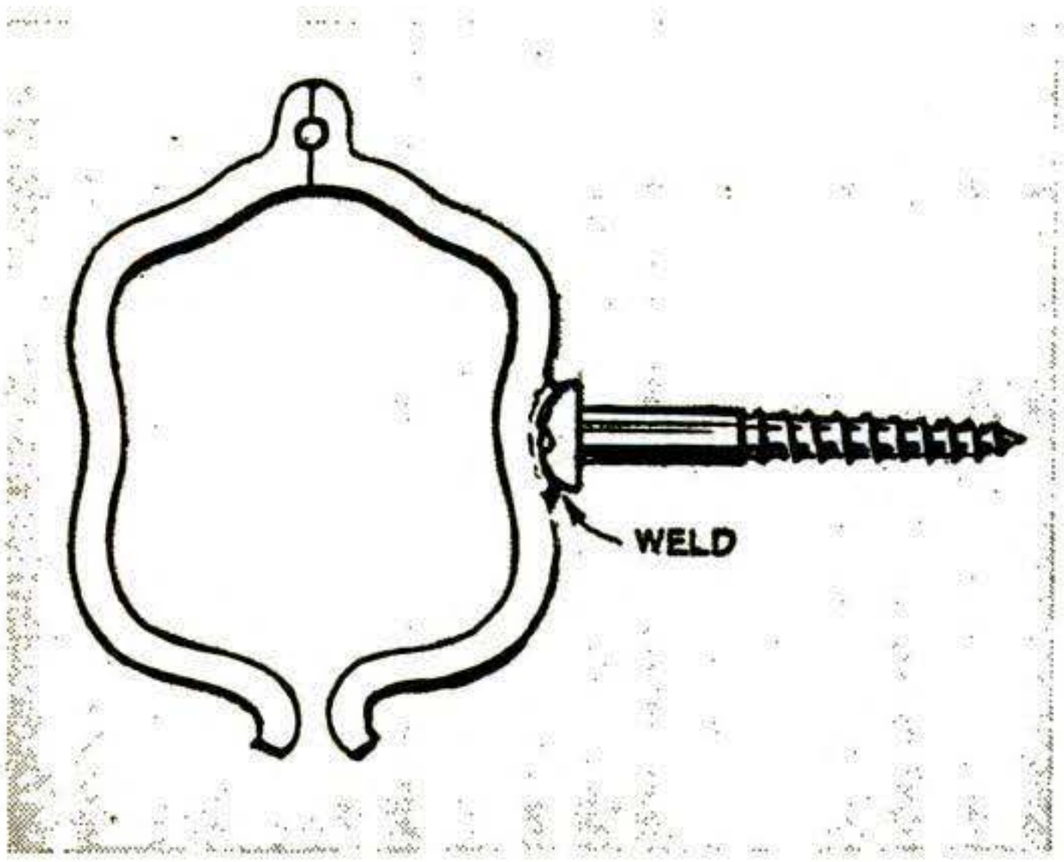
▶▶▶IN A local shop, I watched a welder put a fine edge on his pocket knife. He used a coated welding rod for a hone. The flux coating is abrasive, and it allows a keen edge to be honed on a blade.—*John Krill, North Lima, Ohio.*



Child-Proof Door Stop

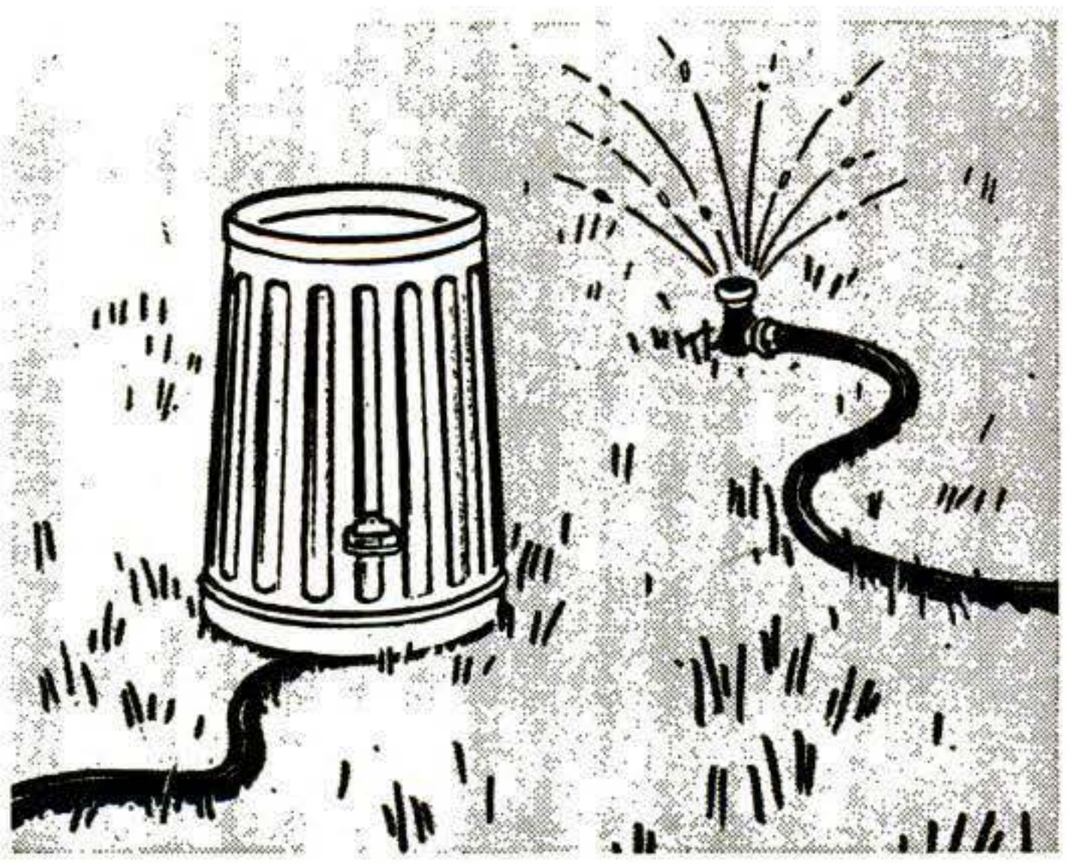
MY YOUNGSTER'S favorite indoor sport was balancing on one foot on the door stop. It bent, then finally pulled out of the baseboard. I thwarted him by relocating the stop high on the wall. Now it butts against the upper rail and works just as well.—*Frank Harazim, NYC.*

▶▶▶PAPER-TOWEL rolls sometimes fit in their racks so tightly that they're hard to turn. Cut a ¼″ dowel to the proper length and insert it through the hollow core of the roll so that it lessens the tension of the rack.—*R. Miller, Lansing, Mich.*



Altering Clamps for Downspouts

STORMS kept pulling my rainspouts loose until I trimmed down the tangs of the pipe clamps and welded on wood screws. I just turn the clamps to anchor them.—*Peter Logan, Malden, Mass.*



Sprinkler Flushes Garbage Can

EACH time the garbage collectors leave, I turn the empty can over a lawn sprinkler. It scours and aerates the interior. No need for detergents.—*Stephen N. Stresnic, Fort Lauderdale, Fla.*

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Fixing TV Front-End Troubles

By Art Margolis

Your TV tuner spins off a surprising amount of "mileage" in a year. At a certain mileage you are likely to have trouble if you don't give it regular mechanical maintenance. All that's needed is to clean and lubricate the contacts. Both jobs are taken care of by a special preparation you can buy in a spray can with a small plastic hose.

There are two tubes in the tuner that will need replacing if certain symptoms show up. The photos and case histories following will tell you when to suspect them.

"THAT'S the last straw! For a week you've been smelling like a dandy and now it's a manicure. Your story had better be good." My wife, Lea, had just noticed the professional manicure on my left hand.

I took a deep breath.

"You're not going to believe this, my sweet, but I fixed a TV in the barber shop today . . ." and I told her the story.

This repair almost had me ready to throw in the towel. Nick had called me

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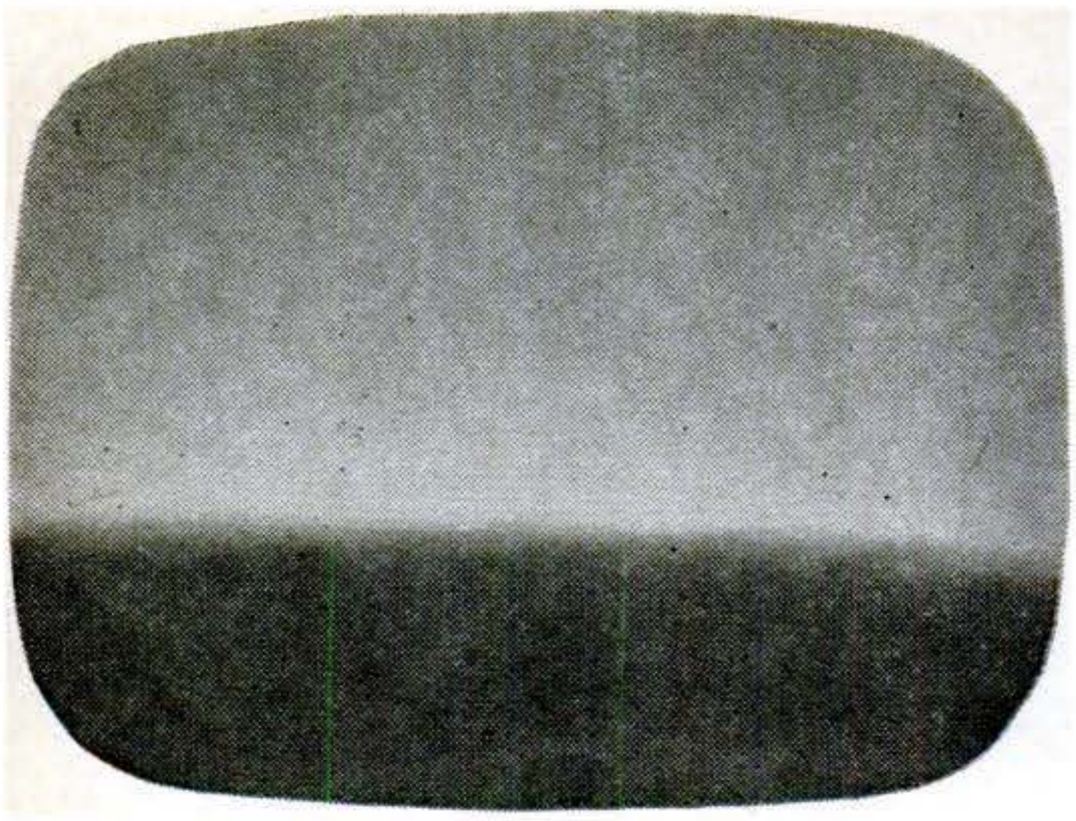
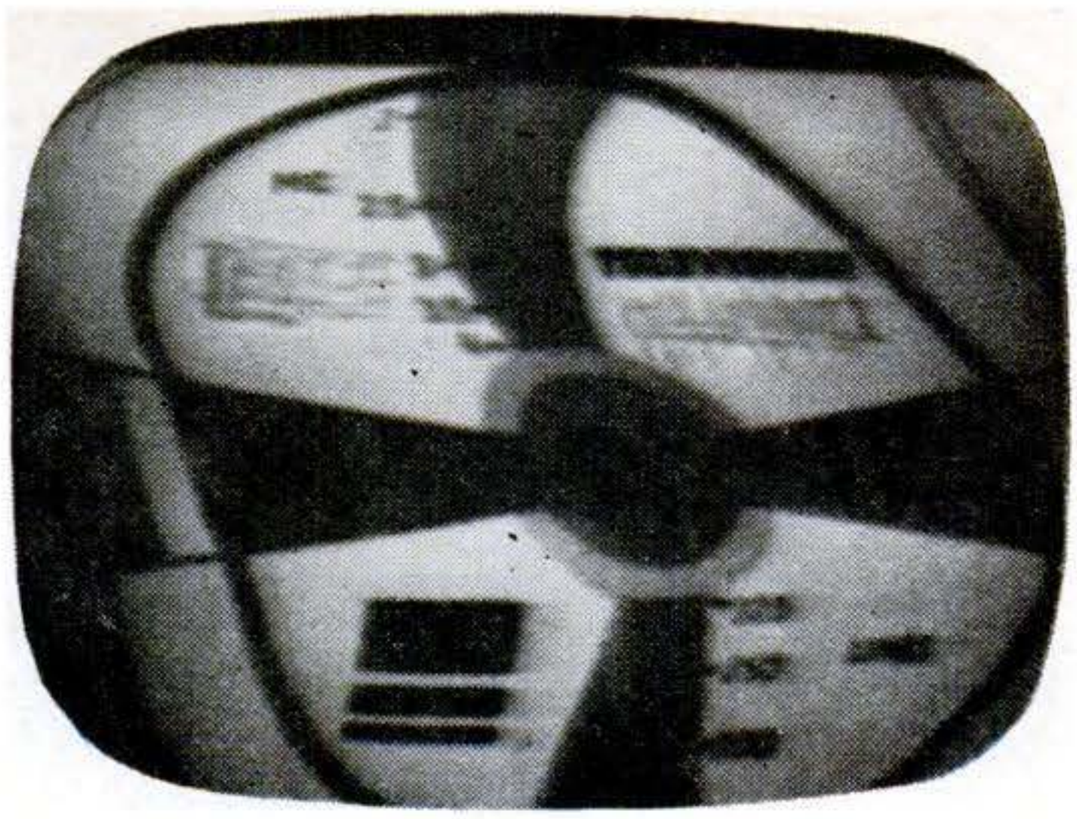
Six symptoms of troubles caused by faulty tubes



BARS ACROSS THE PICTURE—one black and one light—indicate 60-cycle hum. If your set shows these symptoms, the two tubes in the tuner are the first ones you should try replacing.



PULLING AND SLIGHT DARKENING of a band across screen is due to 60-cycle hum, to a lesser degree. Leakage in either tuner tube, too slight to show on a tube tester, can cause it.

a week before. But when I arrived and turned on his set, the picture came in perfectly. It was one of those sneaky intermittents. It played all right while I was watching but conked out after I was gone. I had to depend on Nick's description to try to diagnose the trouble.

"The picture goes black on the bottom, stays okay on the top, and then starts rollin' up and down like crazy."

This sounded like vertical-sweep trouble. The first step with any intermittent is to try to make it act up. I began tapping the vertical tubes with my little rubber hammer. Results negative.

Nick pleaded, "Stick around, Art. I'll give you a haircut while you wait."

After the slowest haircut I've ever had, the TV was still shining brightly. I had to leave to make my next call.

The phone was ringing when I opened shop the next morning. It was Nick. When I reached the barber shop Nick wailed, "Art, she was rollin' like a player-piano roll till you pulled up. Here, you watch; I'll give you a shave."

This routine kept up all week. The set played fine while I became the best-smelling repairman in town. Saturdays, Nick has a manicurist. Just as she finished the last cuticle on my left hand, the TV had a seizure.

No wonder I couldn't cure the vertical condition. The trouble was in the tuner. The RF amplifier (that's the first tube the signal reaches when it leaves the antenna) had developed a heater-to-cathode short. This put 60-cycle AC into the cathode and thus directly into the TV signal. Raw AC went right through the entire set, upsetting the picture-processing circuits, and appeared on the screen along with the picture. The black and white stripes are what 60 cycles looks like when you see it on a TV screen.

There was a buzz in the sound, too, but Nick had neglected to mention it.

I replaced the 4BQ7 RF amplifier tube, and the seizure ceased. Meanwhile the manicurist had started on another customer so I left with my right hand in its normal state.

From the look Lea gave me when I finished the story, I don't think she quite bought it. That is, not till several weeks later when she had to remind me to get a haircut—just like old times.

Schools of Thought

TWO students from a nearby divinity school strode into the shop the other day. Each held a nine-pin miniature tube. I could tell they had been arguing.

They were electronic do-it-yourself fans. Between them they took care of the school's electronic maintenance.

Harris said, "Art, we have a problem. The console in the rec room has troubles. Some channels are real snowy. I think this 6BQ7 RF amplifier is weak."

Robert blurted, "He's all wet. He didn't give you a complete rundown of the symptoms. The low channels 2

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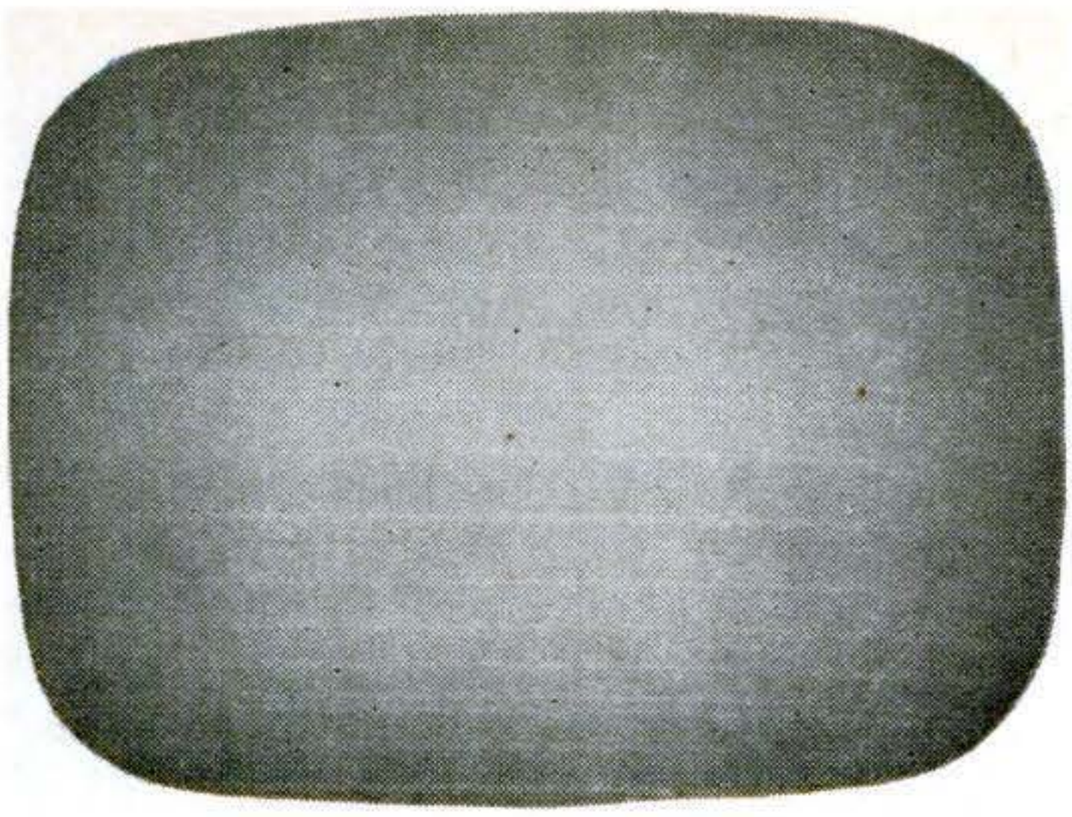


LIGHT ON THE SCREEN but no picture or sound means complete loss of signal. If antenna and lead-in are intact, mixer-oscillator tube is the prime suspect. Check RF amplifier, too.

TV SNOWSTORM points to a weak RF amplifier tube. If the snow (visual static) is only on the upper channels, replace the mixer-oscillator tube. Also check the antenna and lead-in.

through 6 are okay. It's only the high channels that are weak. It's this 6X8 oscillator that's bad."

They both had a sound argument. The 6BQ7 RF amp is the first stage in the TV. If it weakens, all channels suffer. You get static and snow on all channels. But the school is close to our two low-channel stations so there is an exceptionally strong signal. A weak RF tube might not be noticed except on the high-frequency stations. Harris could be right.

The local oscillator is also a prime suspect. It oscillates easier on the lower frequencies. As it weakens, it can become quite feeble at higher frequencies and still work okay on low frequencies. Robert had a point, too.

I explained this to them. They echoed, almost in unison, "Put the tubes in the tube tester and settle it."

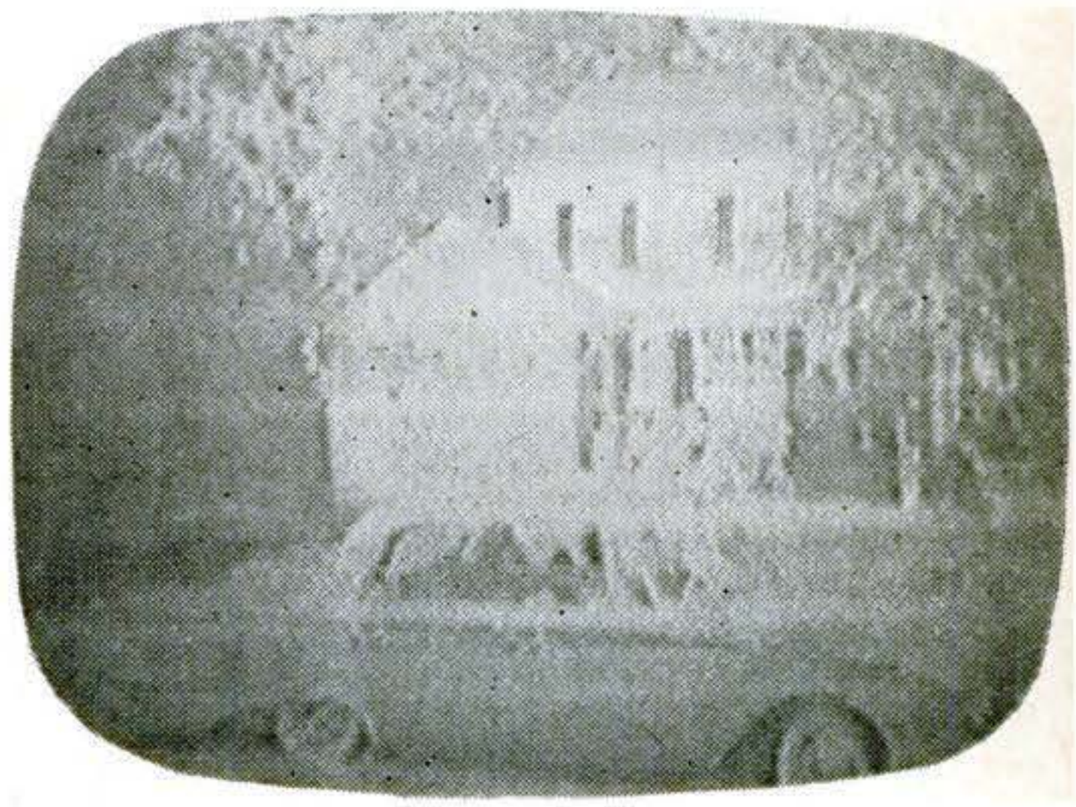
I nodded. "Okay, but remember a tube tester is sometimes misleading, especially where high-frequency performance is concerned. Direct substitution is a more certain test."

I tested the 6X8 first. One section read doubtful and the other was only a bit better. The tube was certainly not dead, but it wasn't very good either.

Harris said gleefully, "There, the tube is okay. I told you it was the 6BQ7 that was bad."

I tested the 6BQ7. The needle climbed just barely into the "Good" region on both sections. "Aha!" said Robert triumphantly.

GHOSTS AND HASH may originate inside your TV. If the fine-tuning control affects this interference, try replacing the tuner tubes; if not, the trouble probably is outside the set.



DISTURBANCES THAT KEEP TIME with the sound are caused by sound getting into the picture. If you can't tune it out with the fine-tuning knob, you probably have a bad mixer-oscillator.

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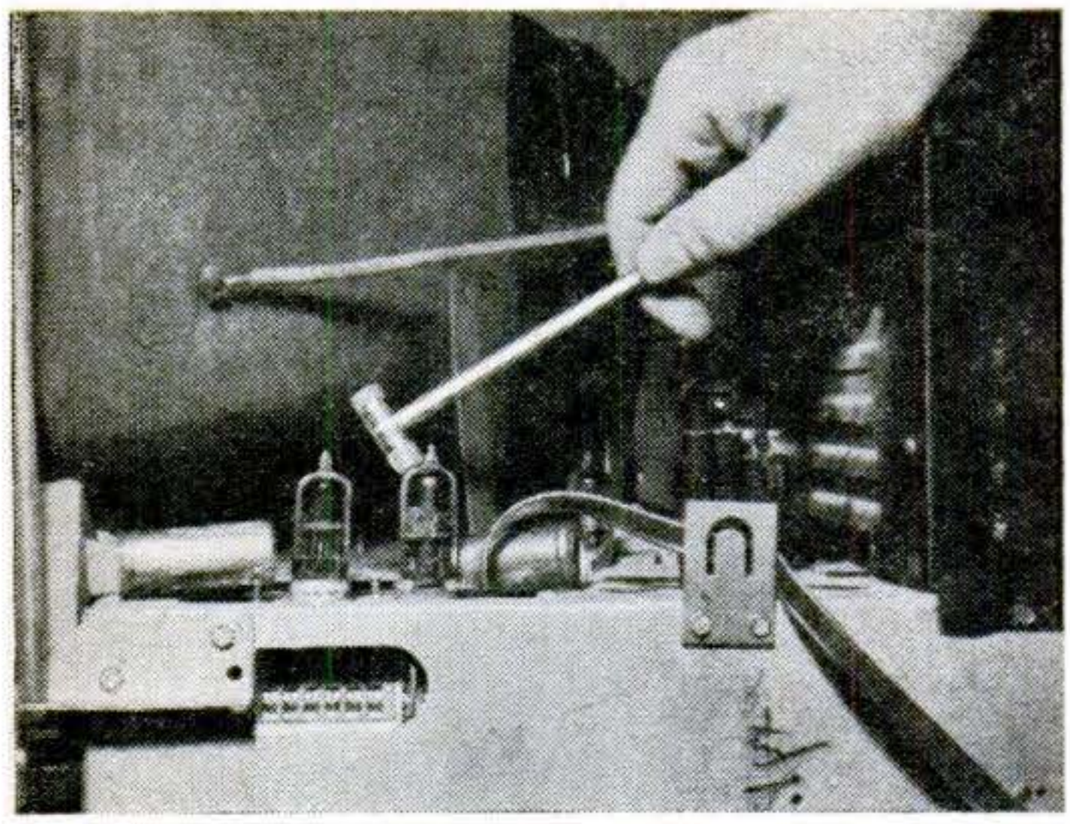
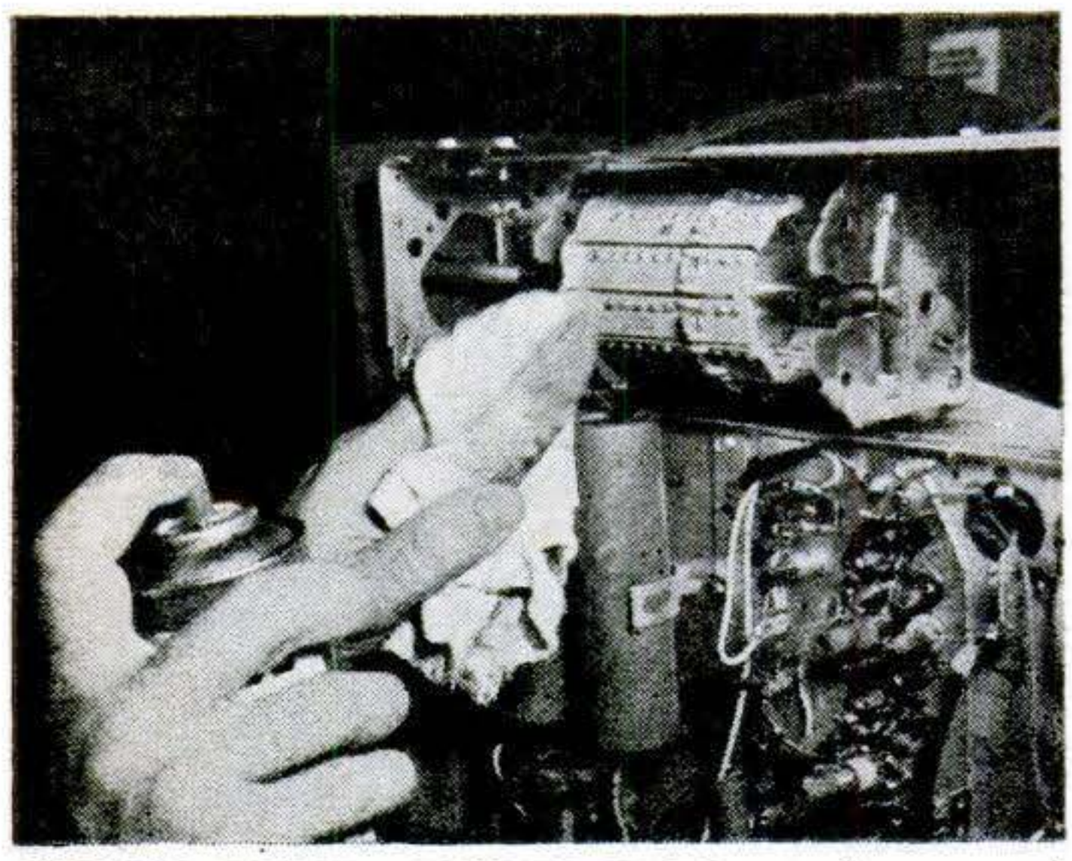
Two tips that may save you the cost of a service call



TAPPING TUBES GENTLY with the rubber end of a pencil will often show up bad tubes. Watch the screen while you work for disturbances of the picture when each tube is tapped.



ERRATIC PICTURE DISTURBANCES can be caused by dirty contacts in the tuner. Clean with special solvent and lubricant available in pressure spray cans sold by radio-parts dealers.

Harris answered back, and their voices soon rose to battle pitch.

I tried to interrupt. "You're both probably right," I said in a loud voice. "Replacing either tube would have cleared up your picture for a while, but you really needed to replace them both."

Mrs. Clean

MRS. LEONARD COLLINGDALE has a reputation for being the hardest-working housewife in our town. She's more than a little eccentric—she's a real bug on cleanliness. In fact, the women call her Mrs. Clean.

I pulled into her freshly scrubbed concrete driveway one morning, went up the walk, and lifted the gleaming brass knocker. The lady herself answered the door. Believe it or not, she had me remove my shoes just outside the door.

As she led me, walking meekly in my socks, toward the TV set, she was exclaiming how the TV picture and sound popped on and off. I didn't look forward to telling her what it sounded like: a dirty, corroded tuner.

The tuner processes the TV signal that eventually becomes the sound and the contrast. The light on the picture tube—the screen brightness—is made inside the set. Thus, if you develop trouble in the tuner, brightness is unaffected while the sound and picture are disturbed.

In this set, the sound and picture would disappear sporadically while brightness was continuous. There are many contacts in the tuner and they have a tendency to corrode and so limit the flow of electricity through them.

The repair is simple—clean them. I pulled the chassis and sprayed the contacts thoroughly, turned the tuner a couple of revolutions, wiped off the contacts and sprayed them again, lightly.

"What was wrong with it, Art?" Mrs. Collingdale asked.

I tried to soften the news that dirt had somehow crept into one of Mrs. Clean's possessions. "Well, you see, for a given concentration of corrosive elements in the ambient atmosphere, oxidation of the tuner contacts is a function of time. Oxidation increases the contact resistance, limiting the RF energy converted to the intermediate frequency."

Mrs. Collingdale relaxed. "Well, that's fine, Art," she said. "Just as long as it isn't dirty."

The TV That Couldn't Explode

ONE sweltering hot day a voice crackled over the phone: "Lieutenant Horner speaking."

An almost forgotten reflex had me answering, "Yessir. Can I help you, sir?"

He snapped, "A 24-inch TV is about to explode. I've taken the necessary precautions to assure safety."

When I arrived, the TV was in the back yard, covered with a khaki-colored metal locker. Neighbors were watching from a respectful distance. The youngish

[Continued on page 221]

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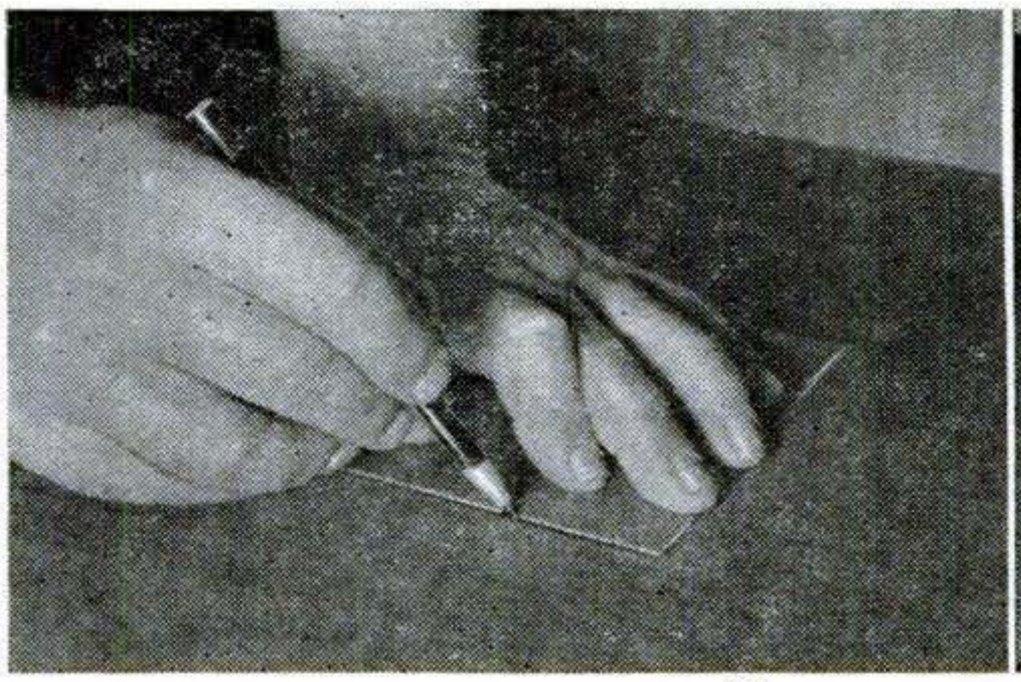
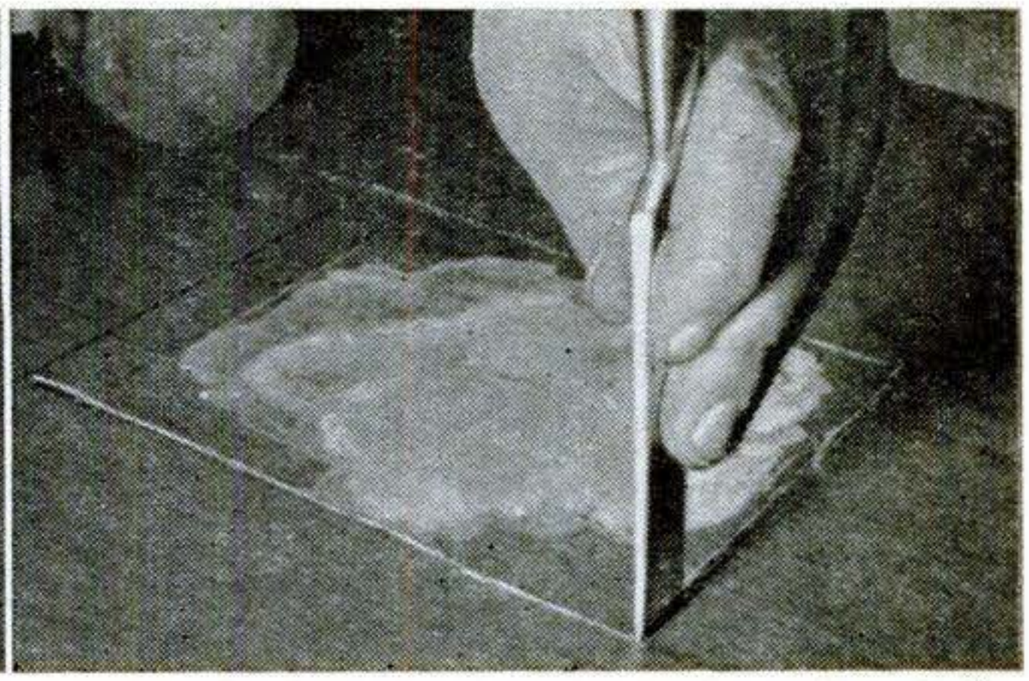
How to Repair Plastic Laminates (II)

EVEN MAJOR DAMAGE, like this burn caused by a forgotten electric iron, need not be a costly catastrophe. Seldom is a patch larger than 8" by 10" called for. If you have no original scraps left over, a patch can be made from a sample swatch available from retail outlets, or from a scrap obtained from laminate fabricators. Most high-pressure laminates have either a high-gloss or a satin finish—usually called furniture finish because it looks like costly wood veneer. For a perfect patch, you must match the finish as well as color, grain, or pattern. The repair job is simply a matter of cutting out the damaged area and inserting a new piece. The success of the job depends on how carefully you do it.

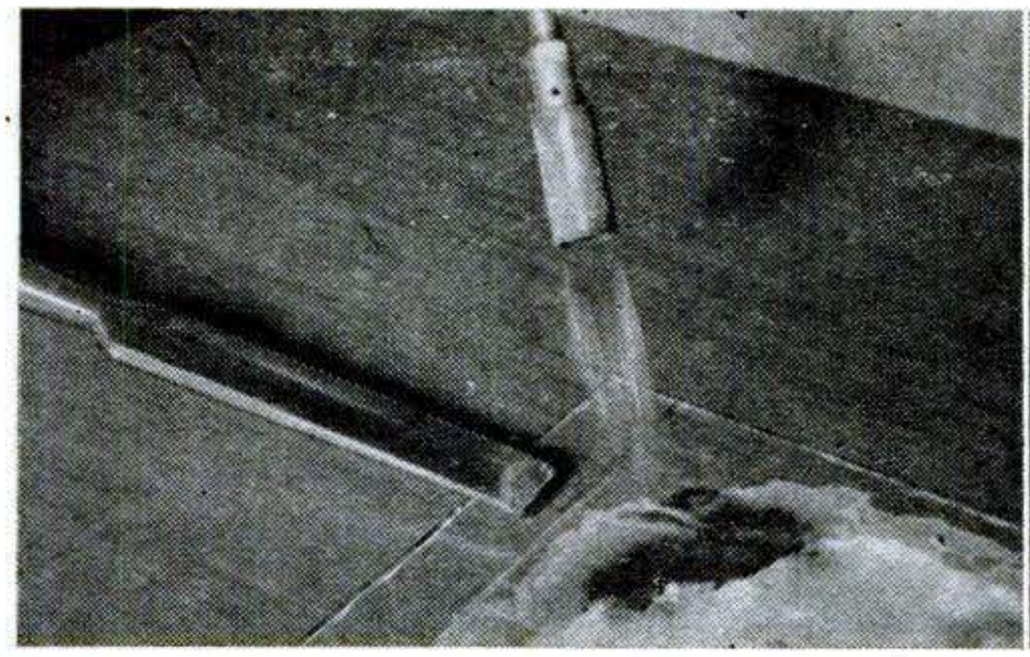
How to repair a badly damaged surface



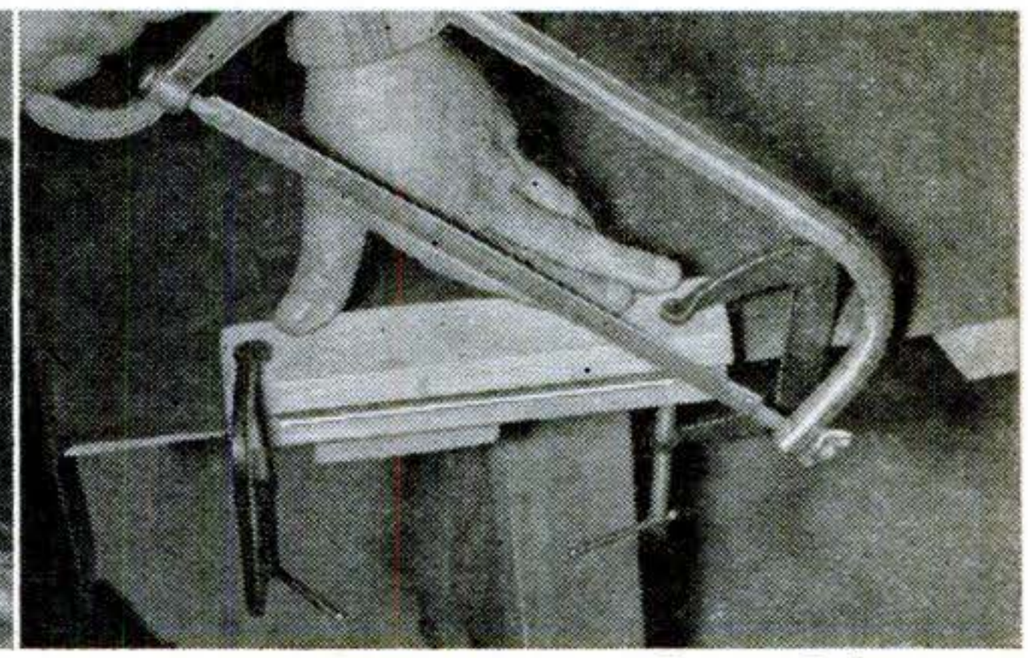
OUTLINE AREA TO BE PATCHED with a grease pencil. If the joint can be concealed in the grain or pattern, adjust the outline to suit. The patch need not be exactly square.



USE A CHISEL AND HAMMER to cut out the damaged part. Hold the chisel so the beveled side of the blade faces the damage, thus assuring a crisp, straight-sided cutout.



HEAT PIECE TO BE REMOVED with a torch to make the adhesive let go. When hot, the laminate can be pried away from the core by inserting a broad chisel under its edge.



CUT PATCH from a piece clamped between two scraps of wood to prevent cracking it. Saw slightly oversize; then carefully file the edges to fit precisely in the opening.

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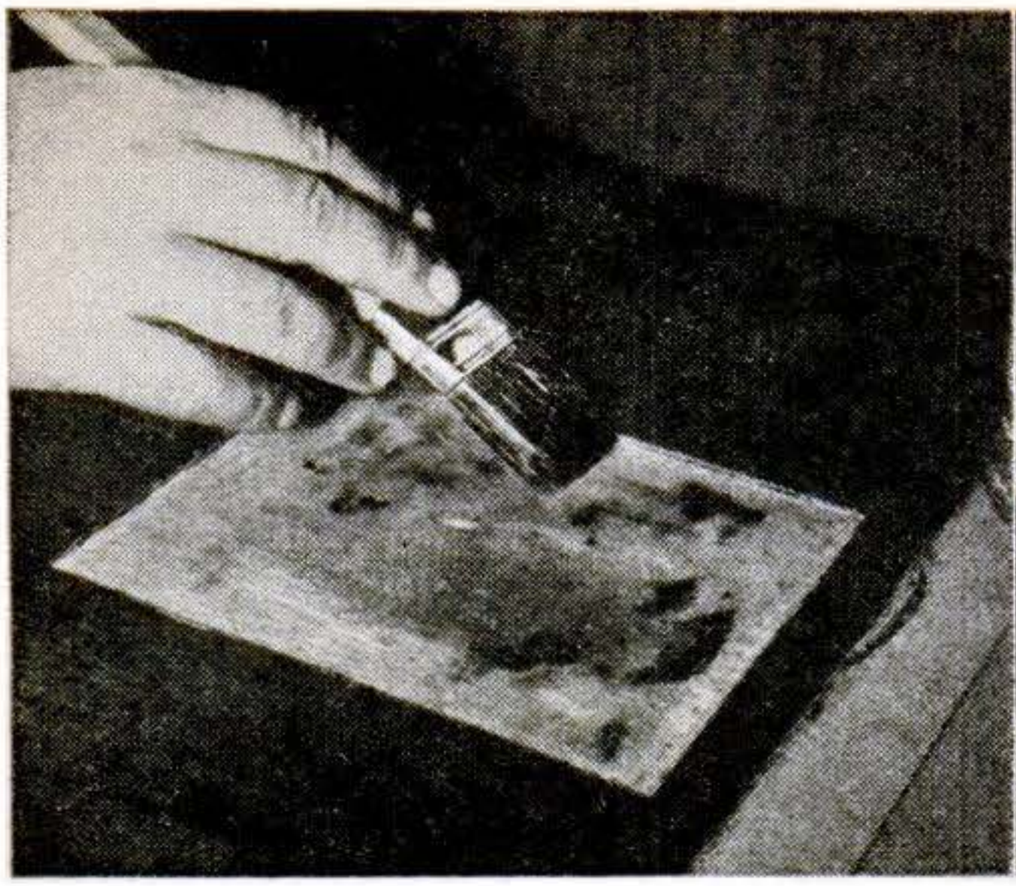
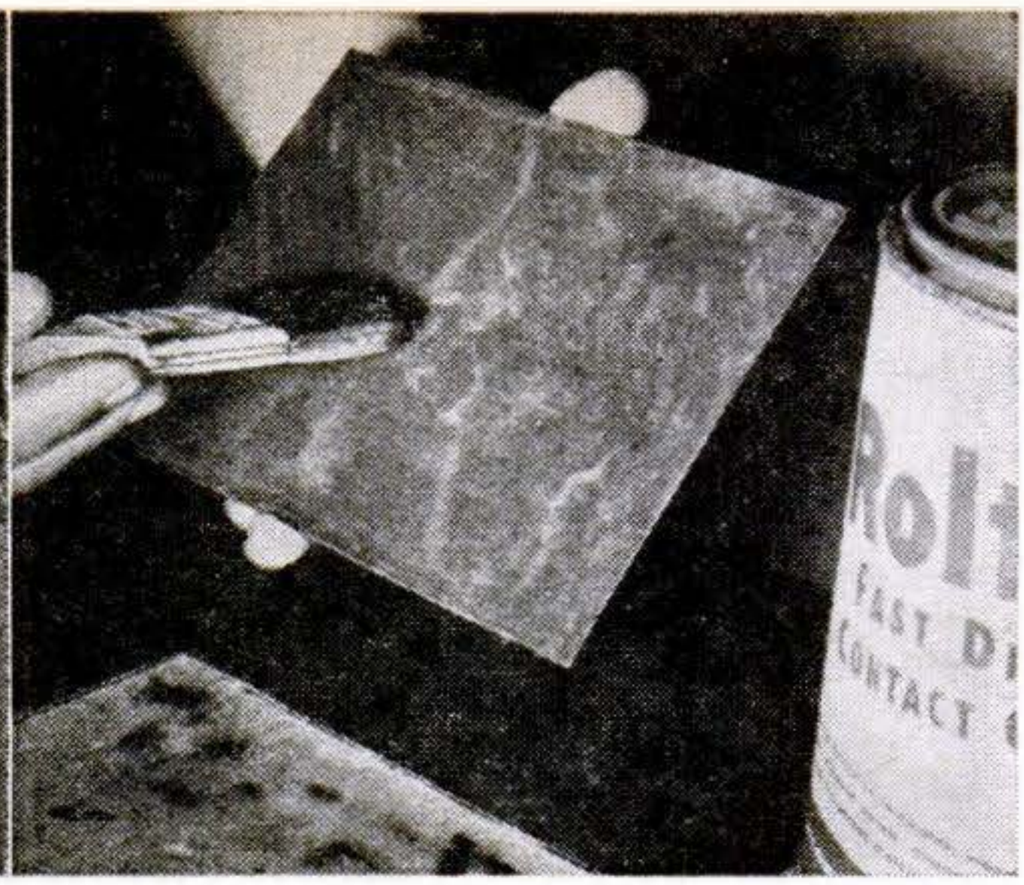
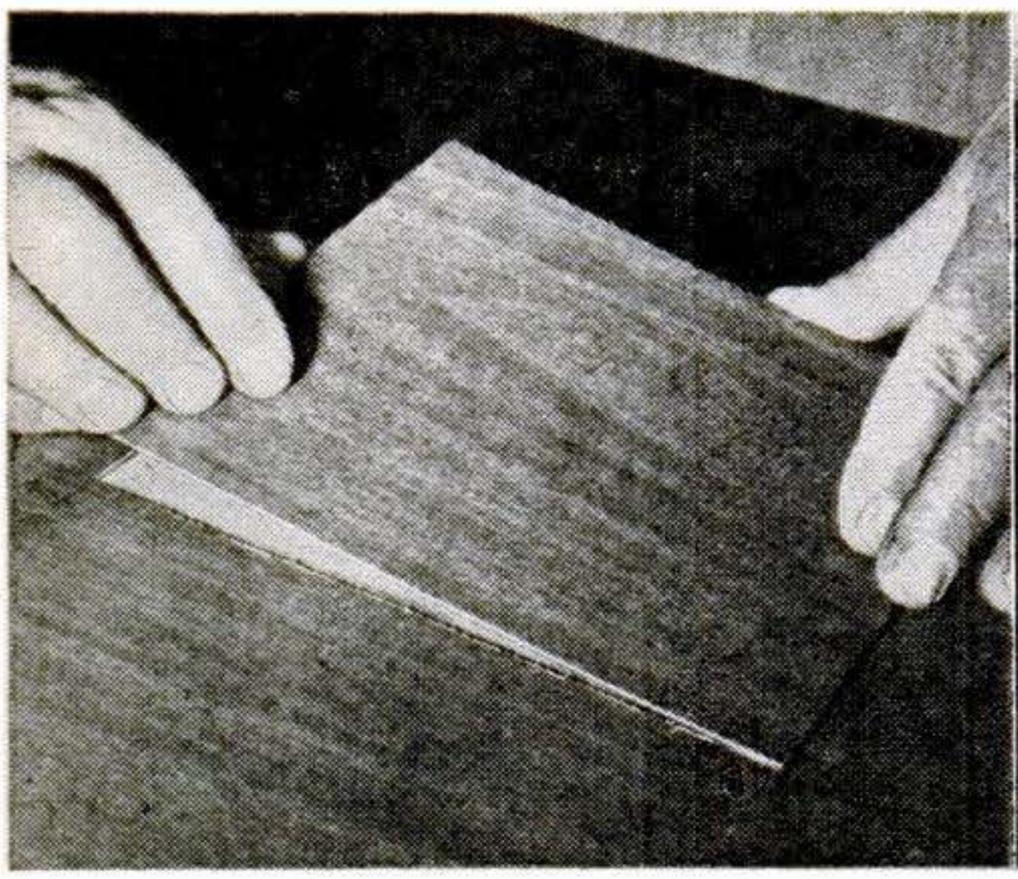
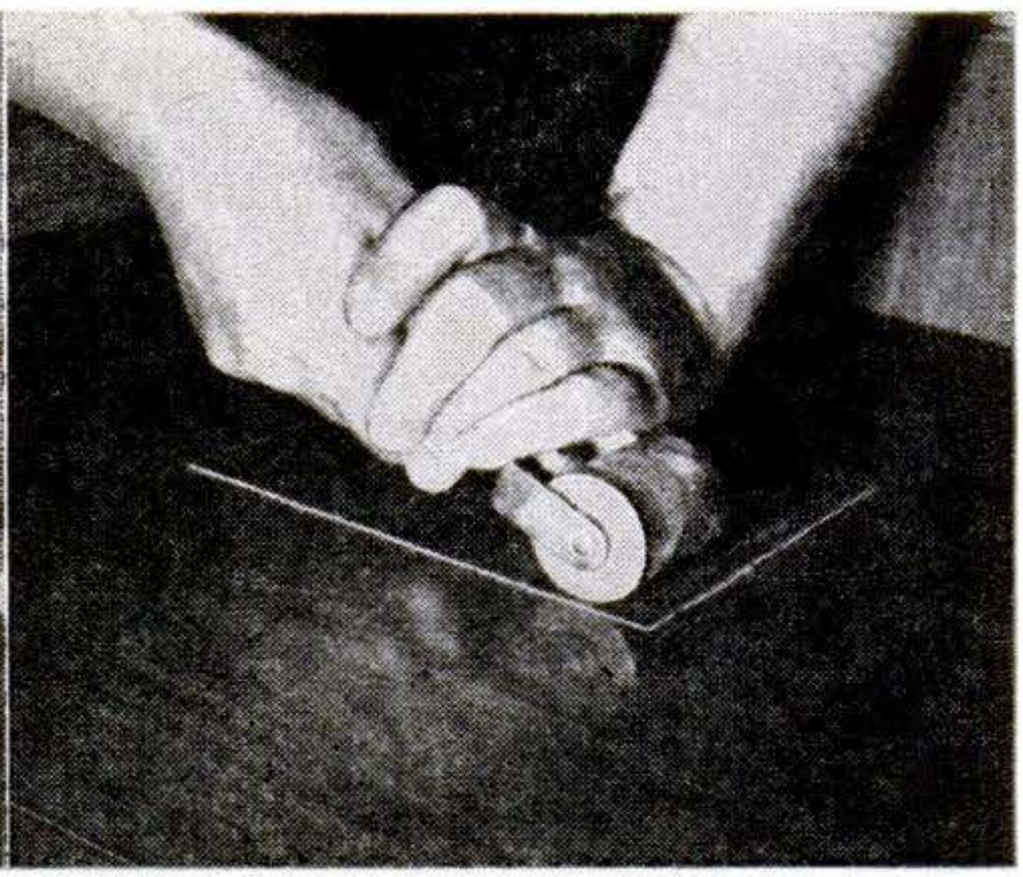




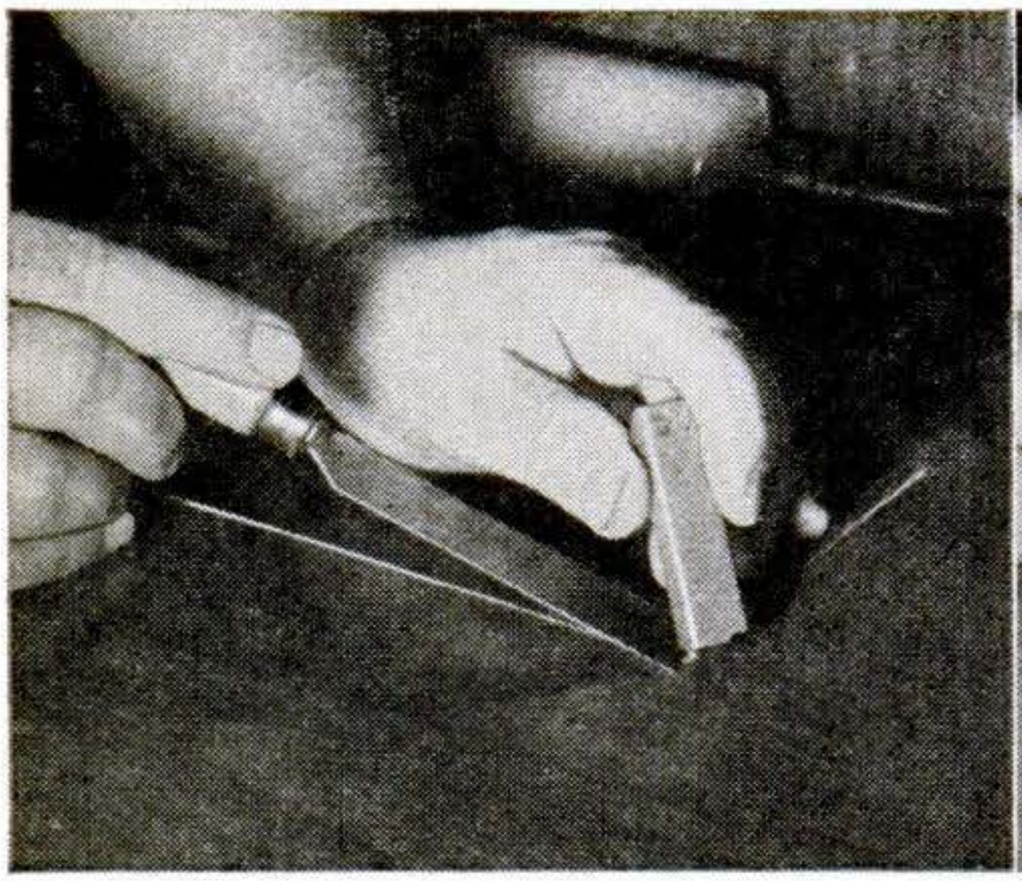
BRUSH CONTACT CEMENT onto the core and allow it to dry for the time recommended by the manufacturer. If the wood soaks it in, apply a second coat. Be sure to brush it out to the edges of the opening. Also apply adhesive to bottom of the patch as above.

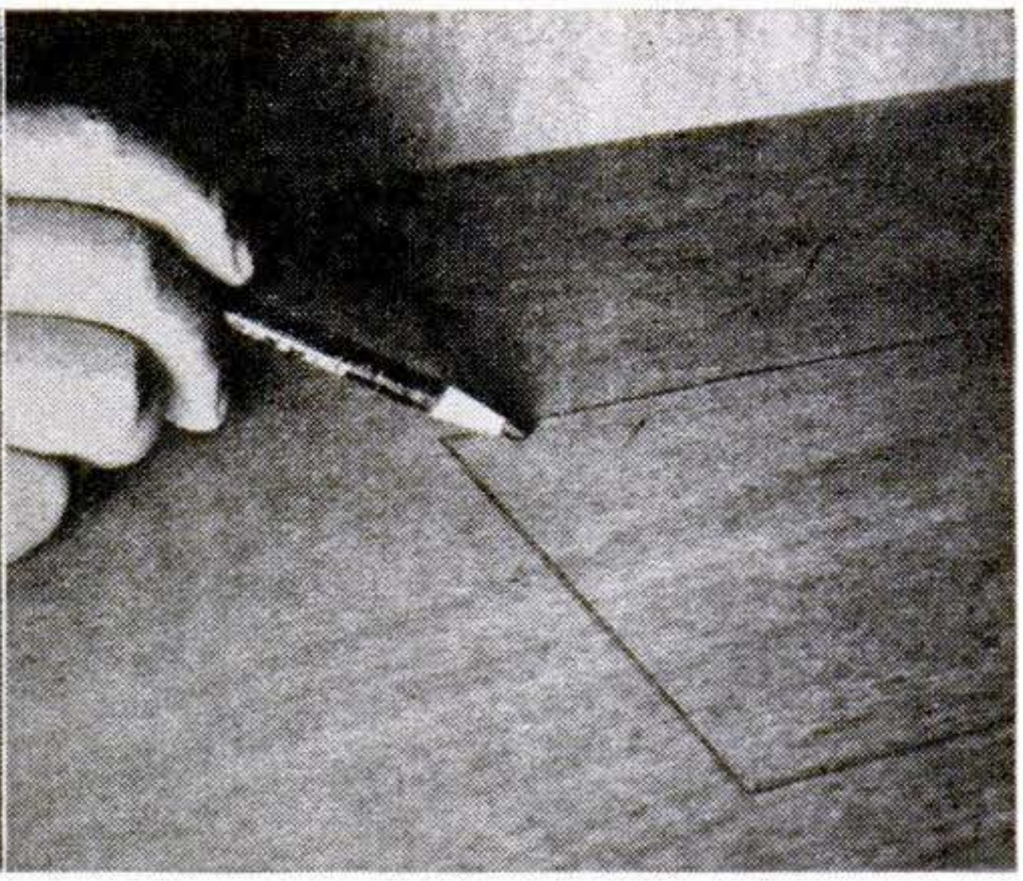




DROP THE PATCH carefully in place. Once it makes contact, the adhesive grips immediately, leaving you no chance to adjust the piece or slide it around to improve fit.

FORCE THE LAMINATE DOWN TIGHT, especially around the edges. Roll outward from the center to press out bubbles. A wallpaper-seam roller is a handy tool for this.





USE STICK SHELLAC and patience to fill in the thin joint around the patch. Heat the putty knife often with a torch or alcohol lamp kept handy. At right temperature, the knife will flow the shellac easily into the crack and scrape off surplus without scratching the surface. Finished repair (above) is nearly invisible after waxing and polishing.

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materials file

The many kinds of Glass for Use in a Home

GLASS can do more for your home than just provide windows to look through. Today it's used to make striking partitions, walls, table tops, shelves, shower enclosures, and sliding cabinet doors. You can get it strong enough to jump up and down on if you want, tinted to cut heat and glare, or textured in a variety of special decorative effects.

Here's how to choose the right type of glass for any job around the home:

Window or sheet glass is the traditional material for glazing windows. It is a fire-polished glass with a slight surface wave in it. The wave is produced as the glass is drawn vertically over rollers. The glass should be set in the frame with the wave running horizontally, since the defect is much less noticeable when parallel to the ground. In ordering glass, list the horizontal dimension first; it will be cut with the wave running in that direction.

Sheet glass is available in single-strength, $\frac{3}{32}''$ thick; double-strength, $1/8''$ thick; and heavy, or crystal, $\frac{3}{16}''$, $\frac{7}{32}''$, and $1/4''$ thick. The thicker the glass, the bigger the opening you can span with it.

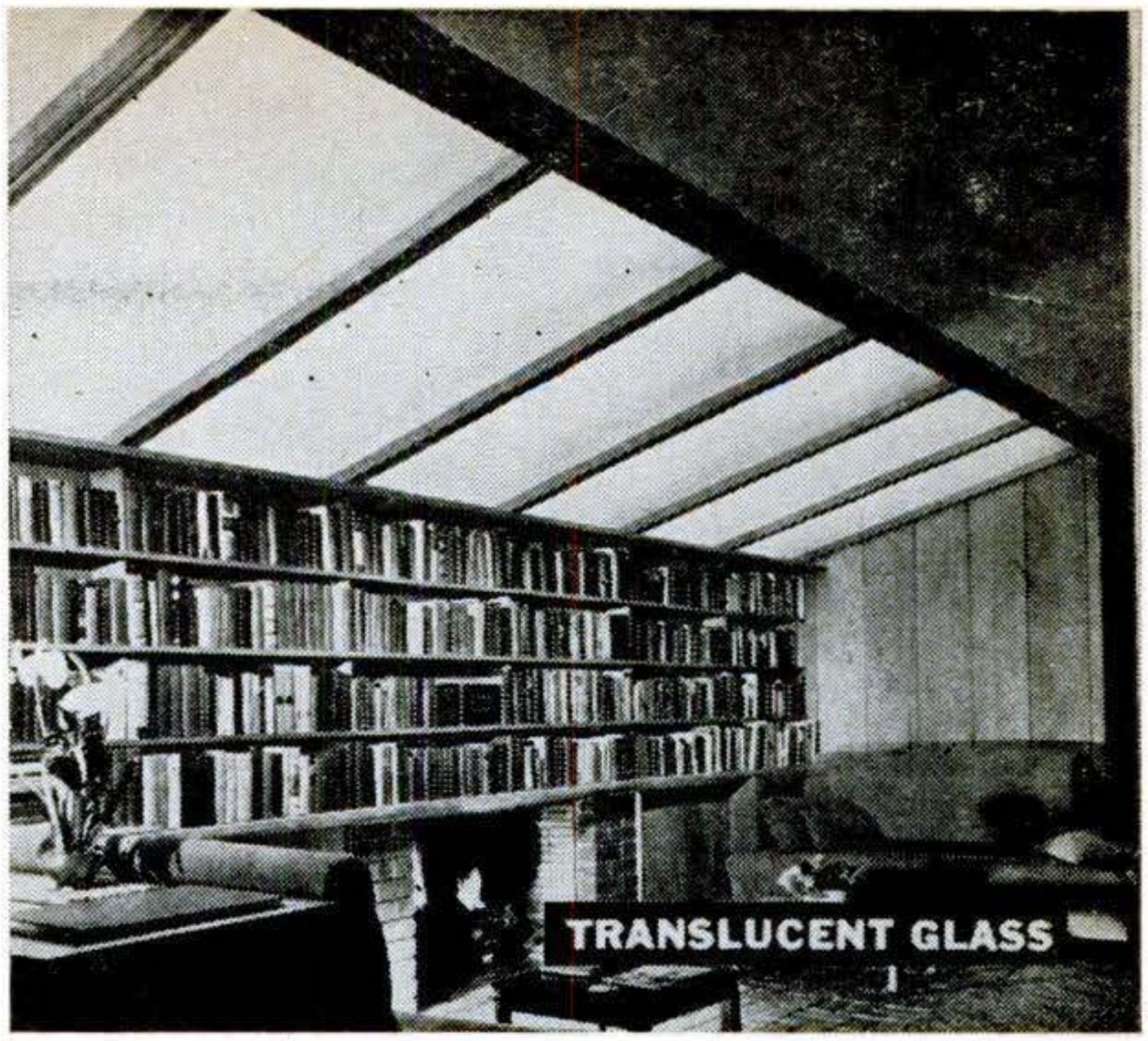
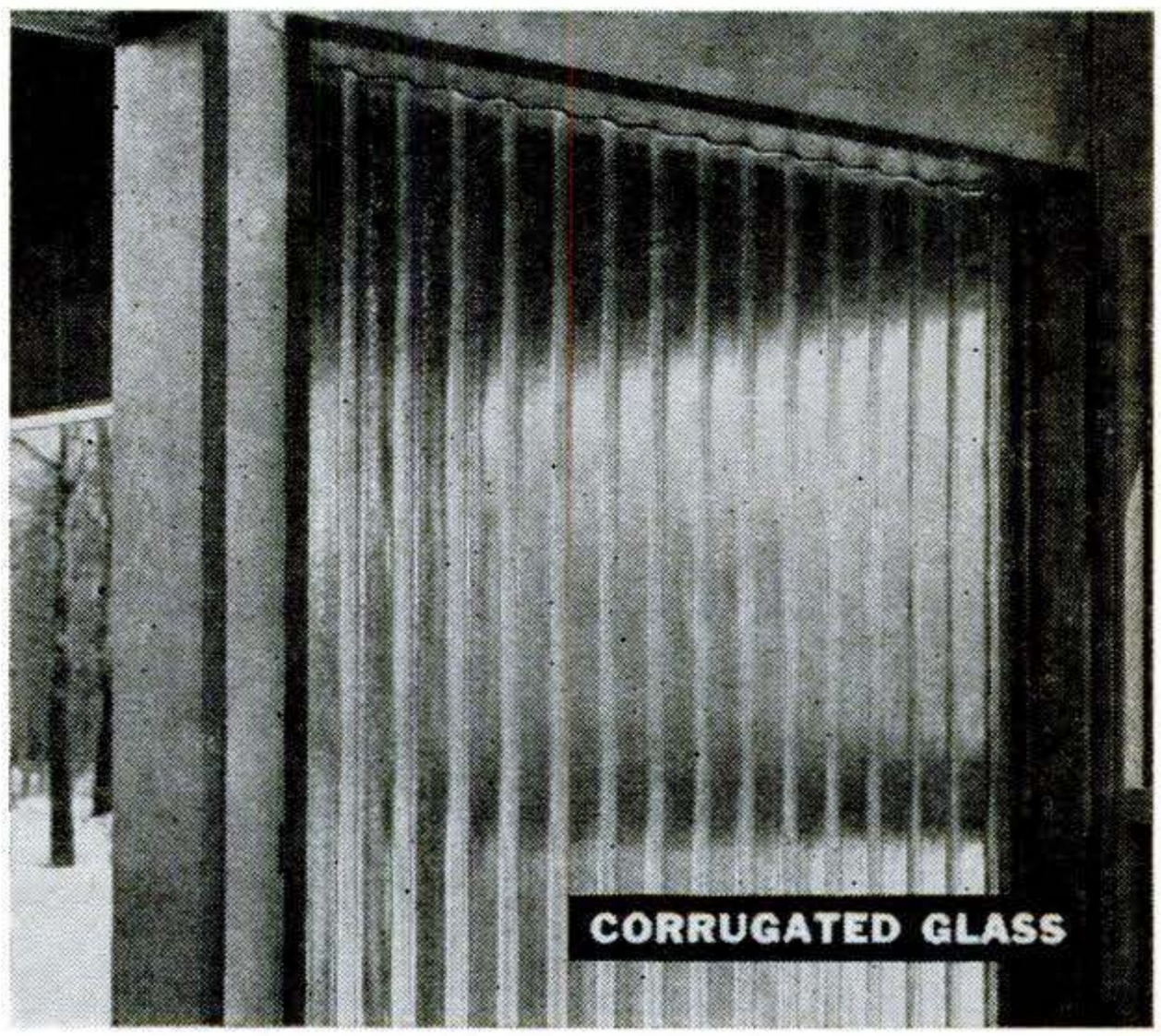

TRANSLUCENT GLASS

PLATE GLASS


CORRUGATED GLASS

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FLUTED GLASS, used here as a shelved room divider, is ribbed to appear corrugated, but is actually almost flat, unlike real corrugated glass. It comes translucent or almost clear.

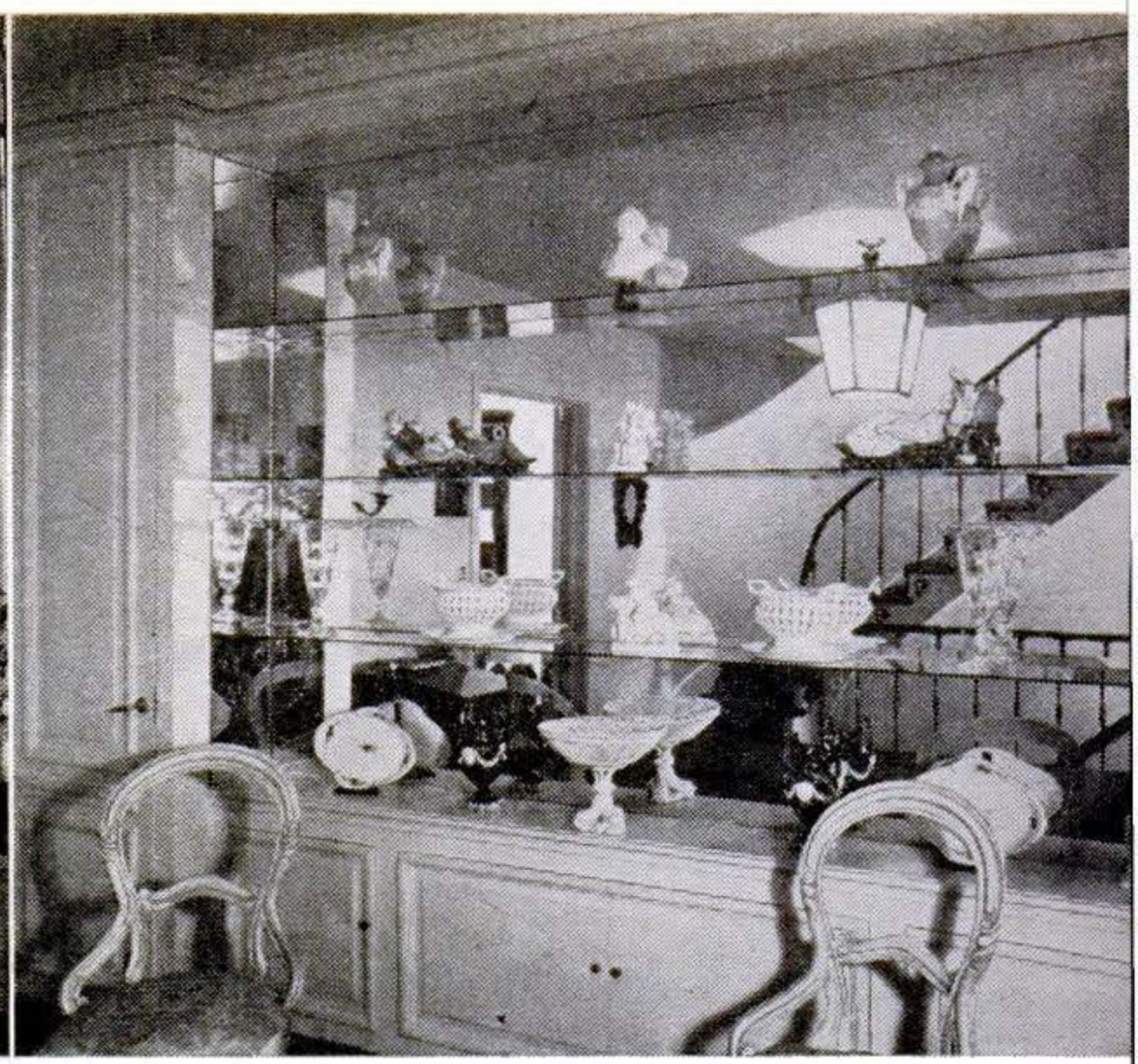

PLATE GLASS, combined with a mirrored backdrop, makes sparkling knickknack shelves. Stronger than ordinary window glass, it will safely span short distances without supports.

The maximum sizes for each type are: single-strength, 3′4″ by 4′2″; double-strength, 5′ by 6′8″; crystal, 7′ by 10′.

Depending on the size you buy, prices range from about 53 to 99 cents a square foot for single-strength, 71 cents to $1.30 a square foot for double-strength. Crystal runs from 93 cents a square foot up to about $2. An extra-thin $\frac{1}{16}$″ glass is also available for picture frames.

Heavy crystal glass is often used as a substitute for more expensive plate glass for doors, shelving, partitions, and furniture tops. Double-strength glass is occasionally used for sliding doors and over fully backed-up table tops, but this is not as wise as choosing a heavier grade. Single-strength glass should not be used anywhere but in regular windows.

Glass experts recommend that a knickknack shelf be at least $\frac{7}{32}$″ thick. A bookshelf should be at least ¼″ thick and be supported every two feet. On longer spans, add an extra ⅛″ thickness for every additional 6″ of unsupported length. A 3′ shelf should be ½″ thick.

Bulb-edge glass has a rounded bulb shape along one edge that gives it greater strength. This is often used for shelving and other exposed edges such as dressing-table tops.

In covering a table or desk top, glass at least ¼″ thick is recommended. If the edges are supported, ¼″ glass is considered adequate for dining tables up to 48″ wide. Cocktail tables that get hard use should not exceed 2′ by 4′. Beyond this size, you need thicker glass. And don't expect to sit on it, as guests and children often do. To be safe, you'd need at least ½″-thick glass for a sit-on table.

For a partition or room divider, much depends on how you frame the glass. If it's made up of many small panes, you can use ordinary window glass. If it's a single large expanse of glass, it should be at least $\frac{7}{32}$″ thick. If it's in a spot where it's likely to be kicked or banged into, you'd better consider going up to ⅜″ or ½″.

Plate glass is a beautifully transparent flat glass with plane-polished, distortion-free, optically true surfaces. You can even get it in colors, with one firm offering steel gray, smoked topaz, sapphire blue, pink, and amber.

Plate glass is generally worth the extra expense only where its sparkling clarity will show to good advantage or where you need a thickness not available in the cheaper grades. It's used for decorative shelves, partitions, skylights, and unsupported table tops.

Regular thicknesses are ⅛″ and ¼″.

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CURVED GLASS, made like an auto windshield, creates a modern bay-window effect. Called laminated architectural glass, it has leaves, butterflies, and other designs imbedded in it.

Maximum size for the ¼″ is 10′10″ by 18′2″. Prices range from about $1.75 a square foot up to $2.75—the bigger the piece, the more you pay.

Heavy plate glass comes in thicknesses of $\frac{5}{16}$″, ⅜″, ½″, ¾″, 1″, and 1¼″—and here's where prices really skyrocket. Plate ½″ thick costs almost $10 a square foot and 1″ plate more than $30. In putting up a shelf or room divider, it obviously pays to design the supports to take the thinnest possible glass.

Rough plate glass, which results from the first step in the production of polished plate, has a pleasing translucent and textured appearance. It can be used where you want to let in light but maintain privacy. It's available from $\frac{5}{32}$″ up to 1⅜″ thick. At $2 to $3 a square foot, it's considerably less expensive than heavy polished plate. It's ideal for shelves, sliding doors, and room dividers where a clear glass is not essential.

Demi-plate, also used as a less costly substitute for real plate, is glass that has been ground and polished on one side only. It is clear, however, and is adaptable to almost any use where regular plate might be considered.

Tempered plate glass is given a special heating and cooling treatment that makes it three to five times stronger than regular plate. It will also withstand temperatures up to 550 degrees without breaking. It is used in homes for shower stalls and fire screens. Thicknesses are ¼″ to 1¼″. Maximum size is 6′ by 9′. Prices start at about $5 a square foot for the ¼″ thickness.

Edge finishing is frequently required for glass, both sheet and plate, used for table tops and furniture. There are four finishes available—swiping, seaming, polishing, and beveling. Each one makes the edges smooth to the touch and beautifies them to a lesser or greater extent.

In swiping, the sharp edges are simply blunted with a few passes at a grinding wheel. In seaming, the edges are somewhat rounded off. Polishing is the full treatment and brings out the sparkle of the glass at the edges. In beveling, the glass is slanted at the edges. Charges for edge-finishing vary from around two cents an inch for swiping, up to 21 cents an inch for beveling.

Heat-absorbing glass and glare-reducing glass are of special chemical composition and are made in both sheet and plate varieties. Heat-absorbing glass has a bluish-green tint. Glare-reducing glass is gray or neutral in tone. The thicker the glass—¼″ is the standard maximum—the better job it does.

Heat-absorbing glass holds back most of the sun's infrared and ultraviolet rays, but lets 75 percent of its light through. It also gives an undistorted, color-true view of the outdoor scene. It is used for windows with a southern and western exposure.

Glare-reducing glass also absorbs much solar heat and at the same time cancels out distracting glare and brightness. Such glass should only be used in very bright locations since it blocks some light.

Besides keeping people cool and comfortable, these glasses also protect furniture, draperies, rugs, and wood finishes from fading. Prices start at about $1.50 a square foot in sheet quality and go up to $4 in plate quality.

Insulating glass is the familiar sandwich composed of two sheets of glass separated by a layer of dry air. Although expensive, this glass is the last word for picture windows and large glass walls since it reduces heating costs and requires no storm windows.

Insulating glass, made by two big man-

CONTINUED

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FROSTED GLASS makes unusual sliding doors for kitchen cabinets. The milk-white glass, ¼″ or 5/16″ thick, has high strength, also comes in ¼″ wired type for extra impact resistance.

PATTERNED GLASS gives privacy but lets in light, making it ideal for decorative effects like this entranceway. The type shown here is ribbed in a crisscrossed, checkered design.

ufacturers, is available in some 60 sizes, ranging from approximately 16″ by 24″ to 72″ by 96″. The glass panes are available in sheet or plate quality and in $\frac{3}{32}$″, ⅛″, and ¼″ thicknesses. Insulating windows are also made with heat-absorbing and glare-reducing glass. Prices are $4 to $5 a square foot.

Patterned glass comes in an amazing variety of textured designs that have beaded, ribbed, fluted, beveled, hammered, pebbled, indented, and floral-patterned surfaces. Wire is embedded in some for extra strength. The translucent glass provides softly diffused light and privacy. It is used for shower enclosures, room dividers, decorative entranceways, and skylights.

Special frosted, etched, and sandblasted finishes are also available. Patterned glass comes in thicknesses from ⅛″ to ⅜″ and in big pieces up to 4′ or 5′ wide and 10′ or 12′ long. Corrugated glass, ½″ thick, is also a popular patterned glass.

The thickness you can use in a partition again depends on how you frame it. Much of the time, patterned glass $\frac{7}{32}$″ thick is used. This is also the thickness customarily used for shower stalls. Building codes in some areas, however, now specify wire-embedded glass for shower stalls. You should also consider wire-glass if you plan to install a skylight.

Prices for patterned glass are generally lower than for clear plate, and in some cases no more than for a heavy grade of sheet glass. They range from about 90 cents a square foot for ⅛″ to $1.50 for $\frac{7}{32}$″.

There is also a patterned glass available in long, narrow strips from 3″ to 6″ wide for use as jalousies, counter dividers, and shelving. It is ready to use as it comes—the fire-polished edges are bright, attractive, and safe. As a safety feature, this glass also has more impact strength than ordinary glass.

Laminated architectural glass. This is the same shatterproof material used in auto windshields, but with one big difference—it has all kinds of colors and designs worked into the plastic-and-glass sandwich. The designs and colors are applied to either the glass or the inner layer of plastic by silk-screen printing, brushing, or spraying. Various inserts, from butterflies and leaves to fabrics and metal flakes, are used to achieve three-dimensional beauty.

This glass is ideal for colorful room dividers, showers, doors, table tops, and decorative panels. It's not cheap, though —$4.50 and up a square foot. Thicknesses range up to 2″, with a maximum panel size of 5′ by 10′. The glass cuts heat and glare and is fine, too, for blocking unwanted sound.

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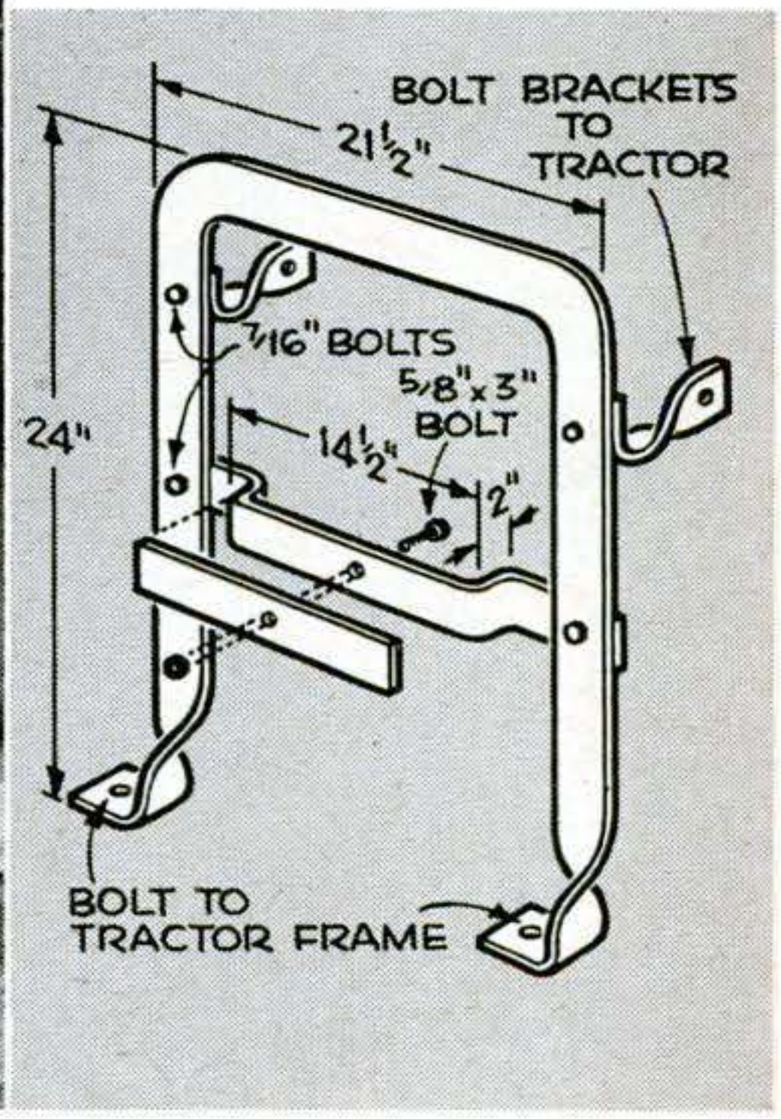
Short Cuts and Tips

FROM PS READERS

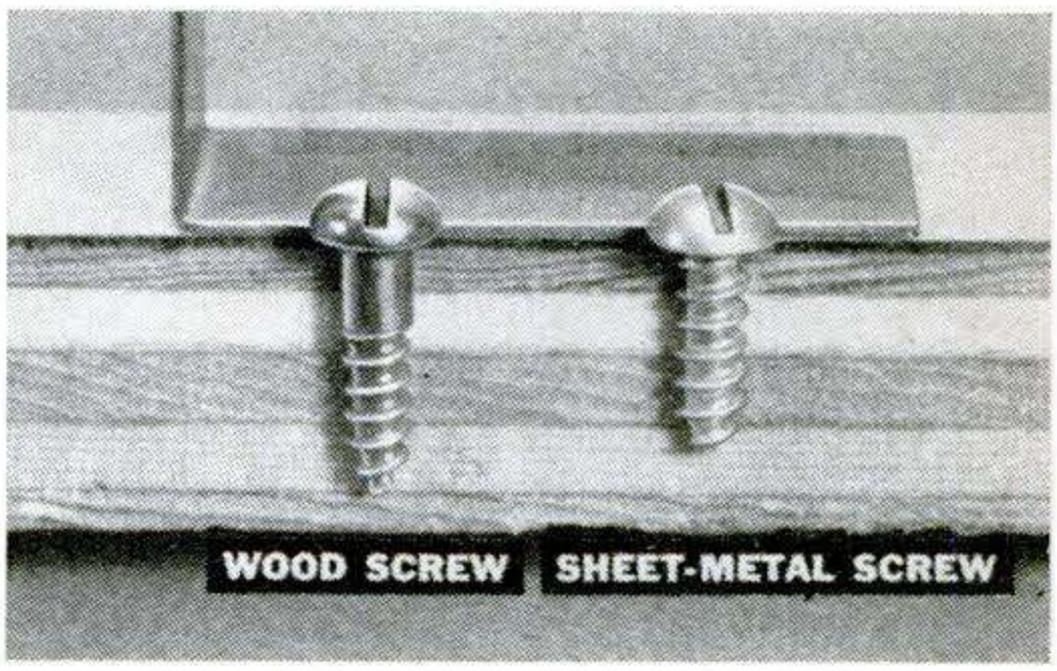


Spare-Tire Rack for Tractor

As a maintenance man on the Natchez Trace Parkway, I was faced with the problem of flats on the front wheels of our tractors. They always seem to happen miles from the base shop. Cars carry a spare—why shouldn't a tractor? This simple rack of ⅜"-by-2" steel keeps an extra tire handy for emergencies. You can adapt the dimensions to your own equipment.—*Garnet B. Sutphin, Tupelo, Miss.*

Sheet-Metal Screws in Wood

For some woodworking jobs—such as fastening thin metal to plywood—you're ahead if you substitute self-tapping sheet-metal screws for ordinary wood screws. You drill only a pilot hole, not a shank-clearance hole, since threads run all the way to the head on a sheet-metal screw. For the same reason, you can use a shorter screw without loss of holding power.—*Robert Micals, Freehold, N. J.*



What's it for?

Answer to puzzle on page 188.

This kitchen tool removes stubborn Mason-jar and other screw-on lids. Turned clockwise, the handle spreads the jaws until they slip over the jar top. A counterclockwise turn pulls the jaws in to grip the rim tightly as unscrewing torque is applied. The tool will tackle anything from a ketchup cap to a 3½" pickle-jar lid. It's called Top-Off and is a product of Edlund Company, Inc., Burlington, Vt.

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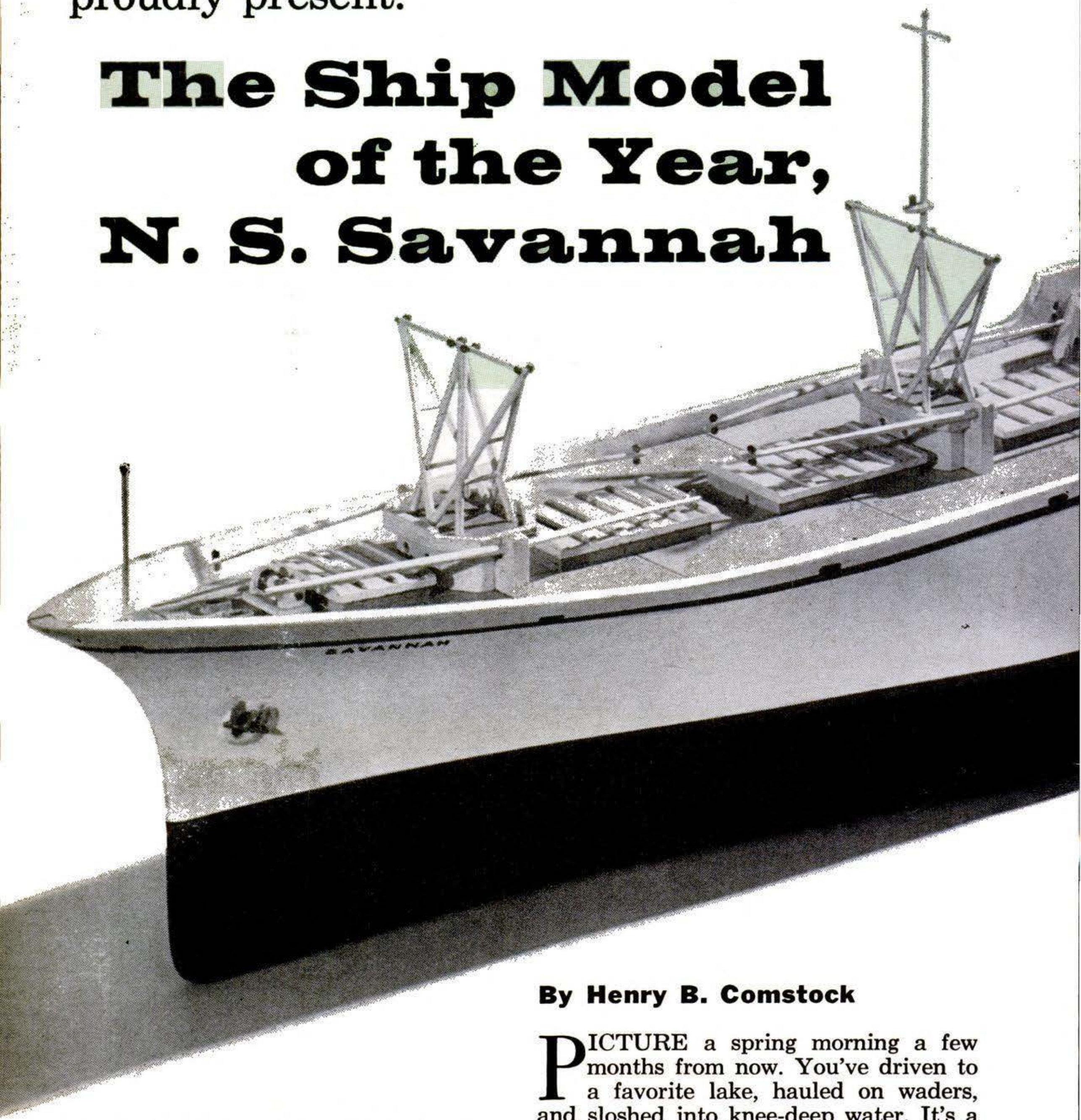
The editors of POPULAR SCIENCE proudly present:

The Ship Model of the Year, N. S. Savannah



That sleek beauty above is a four-foot copy of the world's first nuclear merchantman. Four articles (this is the first) tell you how to build your own

By Henry B. Comstock

PICTURE a spring morning a few months from now. You've driven to a favorite lake, hauled on waders, and sloshed into knee-deep water. It's a big moment, for you're about to launch the most exciting ship model you've ever built. Over four feet long, she's a faithful copy of the N. S. Savannah—world's first nuclear-powered merchantman.

The handsome lines of Uncle Sam's

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$42.5-million "Atoms for Peace Ship" have guaranteed an eye-popping display model. Your baby Savannah's glistening white hull is as graceful as a racing yacht's. Above it, a well-placed superstructure blends airfoil curves with sharply angled planes for a dazzling effect.

But this is only the frosting on the cake. Both the 22,000-ton Savannah and your 22-pound craft pack their real punch belowdecks. In the big ship it's the reactor that will let her plow the sea lanes for three years on a single charge of uranium-oxide fuel. In your model, it's a remarkable new power plant, too—combined with a practically indestructible hull. Here's a run-down on some of the features:

- *Turbine drive.* This is the engine steam buffs have dreamed of for years.

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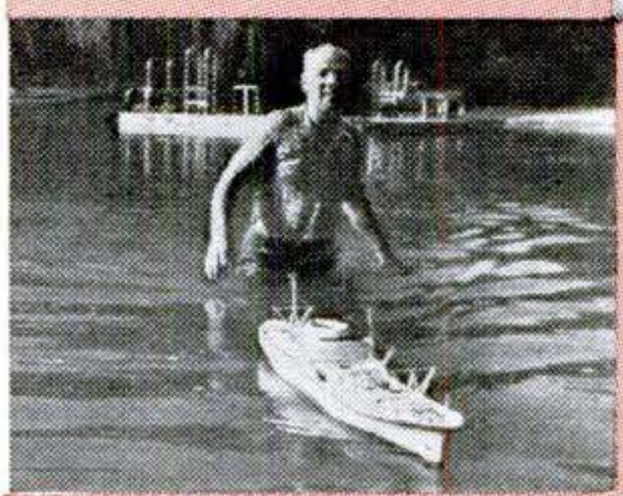
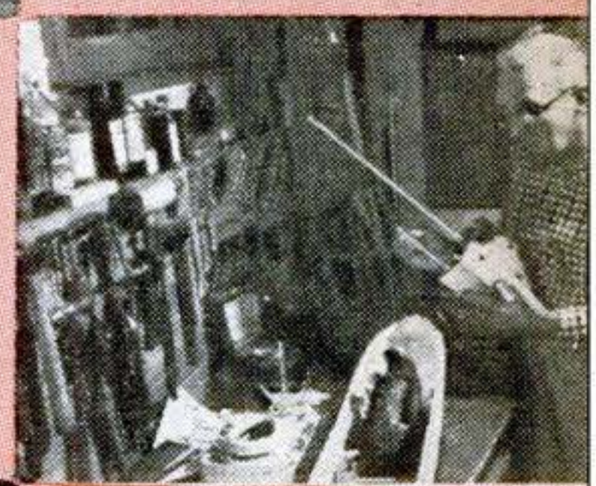
The men who built the model

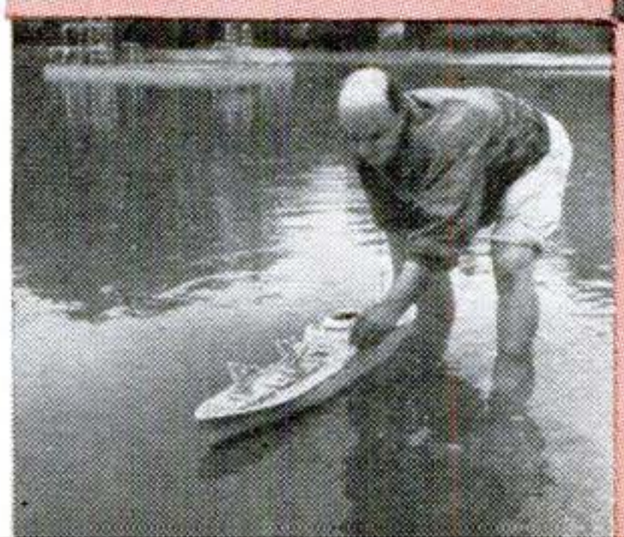
1. Henry Comstock, ex-editor of *Railroad Magazine* and ex-associate editor of PS who now free-lances as a writer and artist, planned and built the model.



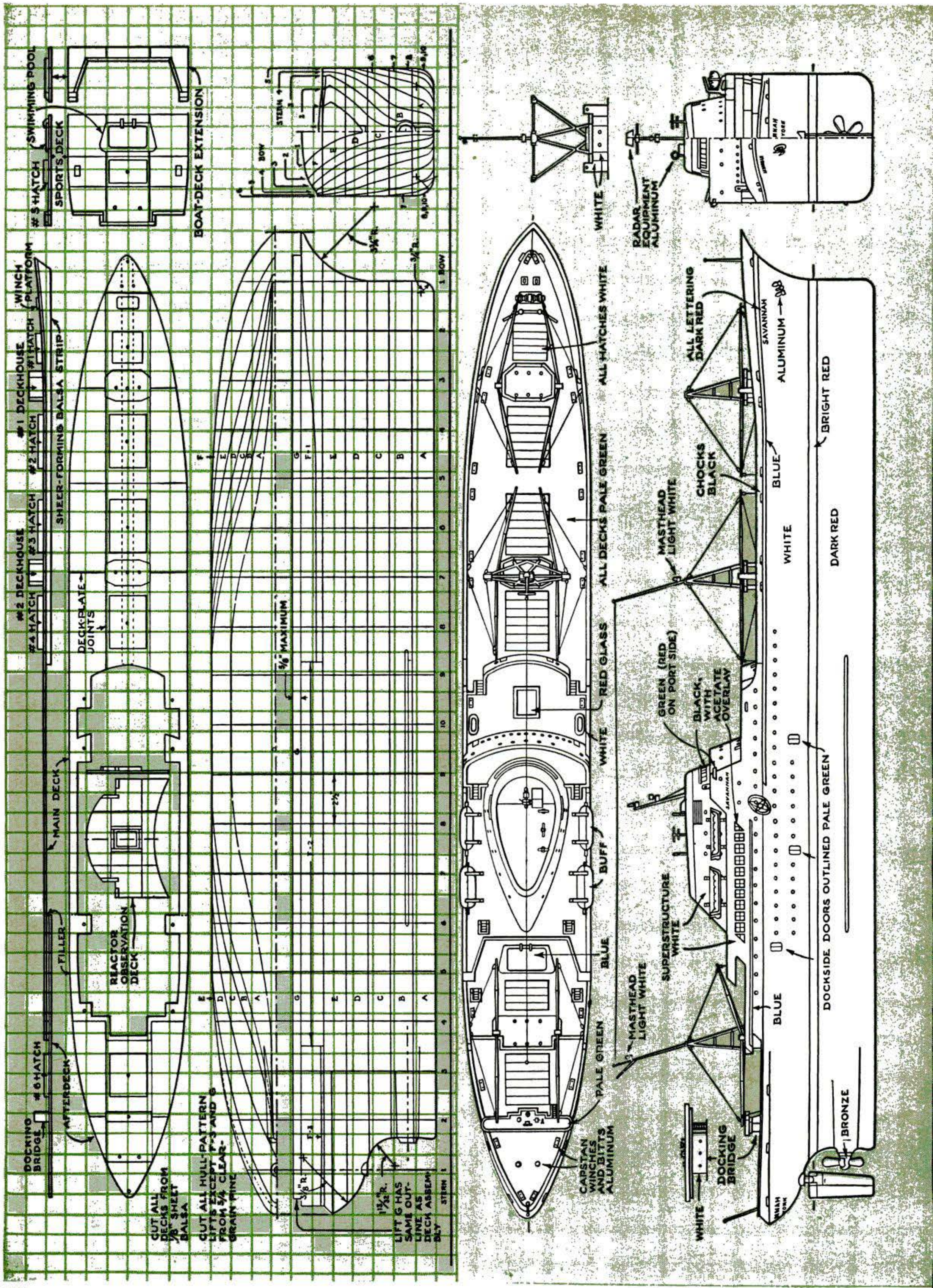
2. Floyd McGuckin then took over and designed and built a steam turbine to drive model. Floyd rescued it (left) when steam ran out on a trial run.



3. Howard McEntee, the third man on the team, fitted out the model for radio control. He's an expert in the field of R/C.



4. Herbert Pfister, PS associate editor and former model-maker, was general overseer of the project, running many tests to insure ship would perform well.



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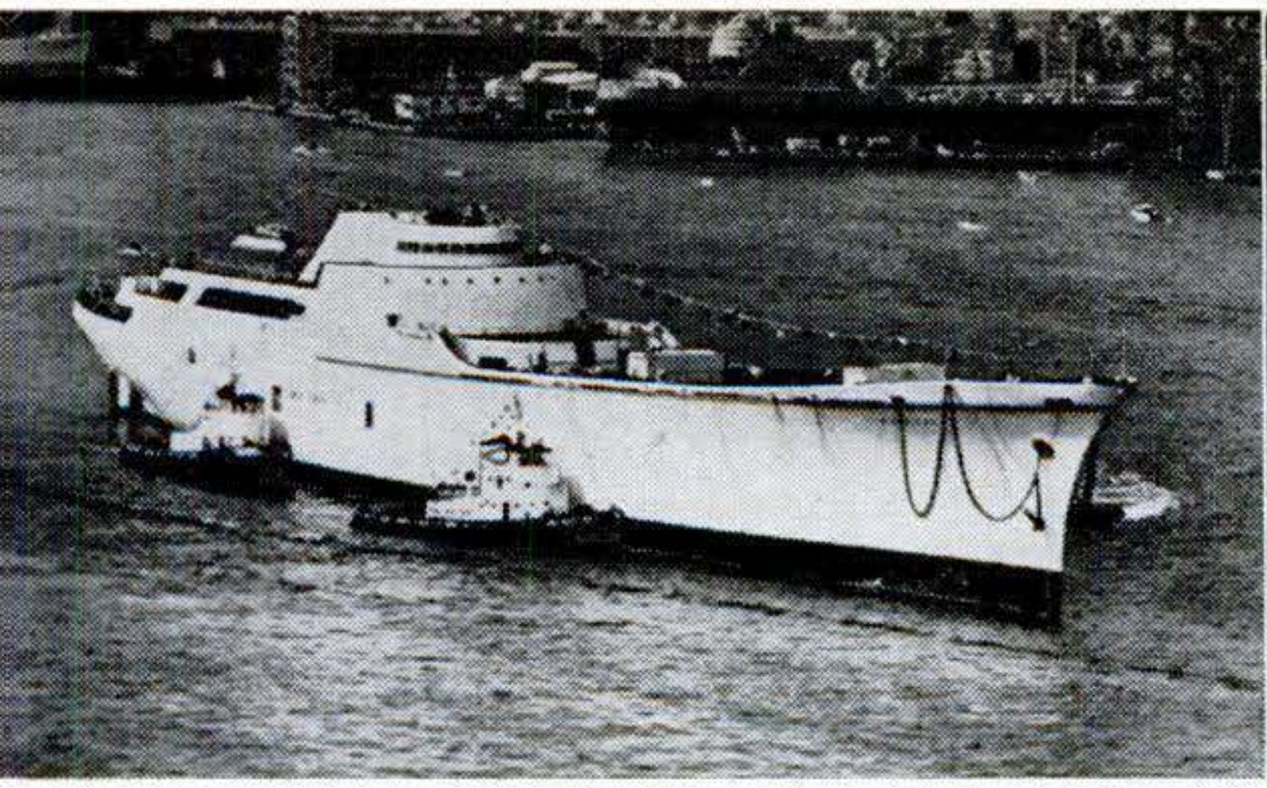
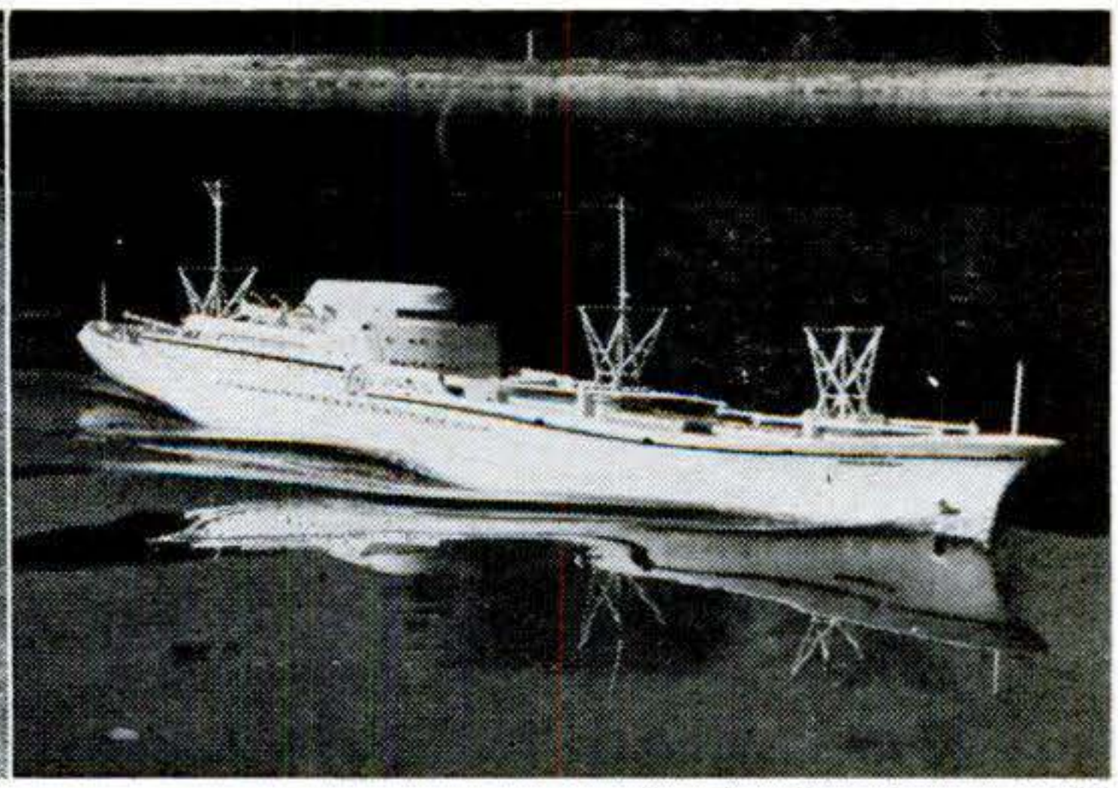


REAL SAVANNAH is shown here in the Delaware River after christening by Mrs. Eisenhower on July 21, 1959. Still to be fitted out, the ship is light and rides high in the water.



MODEL SAVANNAH, completely fitted out with nearly 14 pounds of boiler, turbine, gear-reduction unit, and radio controls, cuts wake through quiet waters of a boat-sailing pond.

In the past, model single-stage turbines have been notoriously inefficient, bleeding their boilers as fast as a punctured dome. This one doesn't. It has a tiny admission port that jets steam effectively against the 30 blades of a featherweight aluminum stator. At the same time, the rate of flow is so miserly that your Savannah will run at full throttle for 30 minutes on a pint of water. To produce high torque, a gearbox with a 50-to-1 gear reduction is placed between the turbine and propeller shaft. As the thin whine of the rotor levels off at 10,000 r.p.m., the model gracefully splits the wavelets at a scale speed of better than 20 knots.

• *Fiber-glass hull.* A tough and resilient one-piece casting, it has the basic color cast right in. There's no worry about disfiguring scratches or chipped paint above the water line. You get another bonus, too. Once you've made your pattern and mold, you can form as many identical hulls as you like. Obviously you don't need a fleet of Savannahs—but how about a special second hull, equipped with lights and a speaker unit? Set it permanently on the mantelpiece. Then, when the sailing's over, cap it with your operating model's easily removable superstructure. A flick of a switch and Savannah II will come alive with twinkling portholes and recorded harbor sounds.

• *Super boiler.* Only a fiber-glass hull, or one of comparably light and thin-walled construction, could cradle a boiler as big, sturdy, and safe. The superstructure, too, offers ample room for a high stack and steam exhaust. The model's simulated reactor well makes a convenient window for checking the steam gauge. With the needle pegged at 40 pounds of pressure, the turbine delivers full power.

• *Flexibility of radio control.* By running the control operations in sequence, you can pilot the ship with a low-priced single-channel R/C rig, costing about $85 complete with transmitter. Its course may be a bit erratic, though, because you must run through throttle and reverse rapidly each time you steer the ship. A $170 four-channel outfit—one for throttle, one for reverse, and two for steering—will provide precise control for complicated maneuvers.

• *Easy access to operating gear.* You don't have to fumble among easy-to-break parts when you remove the superstructure. Simply lift out the small reactor observation-deck section and pry gently. Off comes the main deck and everything above it in a single unit.

• *Seaworthy size.* Narrow beam, in relation to length, makes ships like the big Savannah poor prototypes for too-small operating models. With yours, there's

ENLARGE THESE CONTOUR PLANS by ruling 1" squares on a large sheet of paper. Plot the curves full size from the squares superimposed on this drawing. Or have the drawings blown up to full size by a photostat service.

YOU CAN ALSO BUY FULL-SIZE PLANS from the author. Send five dollars ($5) by mail order or check, with your own name and address clearly written, to Henry B. Comstock, 334 North Greenbush Road, Blauvelt, N.Y.

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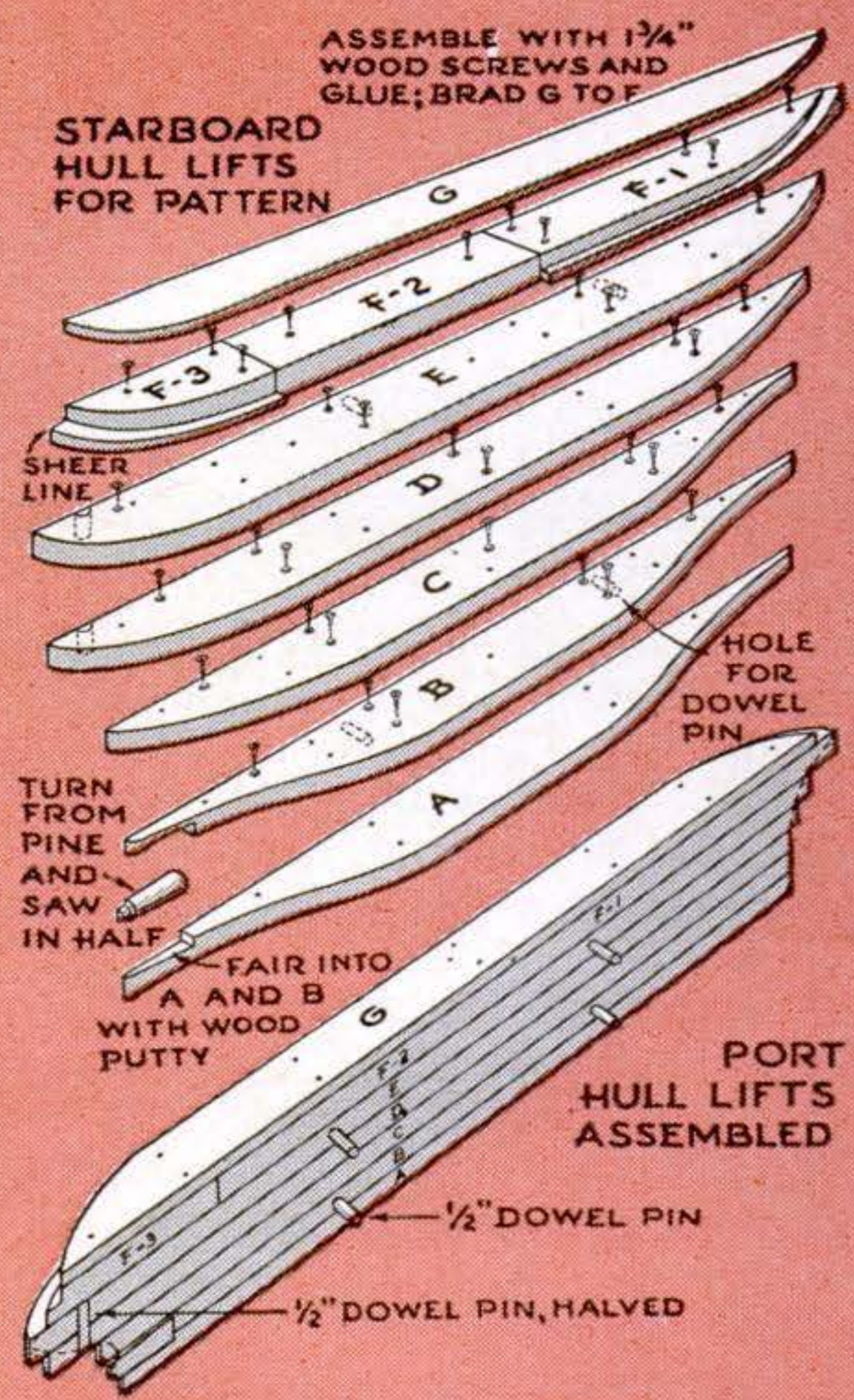
Carve a wood hull pattern and use it to make the mold



PATTERN HALVES are placed in frames and plaster is poured over them to make a two-piece mold. The drawing at right shows how the wood pattern is made by gluing preshaped lifts into a layered form. Steps are then carved and filed smooth until cardboard templates fit the hull at all station points. Dowels bring the two halves together accurately.

no need to wait for mirror-calm water. Her 1/12″-to-the-foot scale insures fine stability. At the same time, she fits comfortably on the back seat of your car for transport. Overall length is 49″. She has a 6½″ beam, draws 3½″, and stands 13″ to the tips of her cargo king posts.

The wood hull pattern. Shaping a wood pattern is easier than forming a finished wood hull. First, the pattern doesn't need hollowing. Second, it's made in two separate, mirror-image sections. As a result, you can place corresponding layers, or lifts, back to back, and cut and sand them simultaneously.

You'll need five thicknesses of 1⅛″-by-3¼″ dressed clear pine for each pattern half. Saw corresponding sections to length and tack them together with brads. Use your contour drawings and carbon paper to transfer the correct lift outline to one surface of each resulting sandwich. Jigsaw along the lines, sand, and remove the brads. Note that the *F* lifts are sawed apart in two places to form *F-1*, *F-2* and *F-3* sections. Narrow the *F-2* units to 3″ with rip cuts.

Assemble the lifts of each pattern-half with glue and wood screws. Then cut a sixth pair of lifts conforming to the shape of the main deck from any stock up to ⅝″. Their exact thickness isn't important, because their only purpose is to form an opening at the top of the mold. Brad these *G* lifts to the *F* lifts and use a hand router or sharp knife to continue their outlines down into the *F-1* and *F-2* sections, as shown in the perspective drawing. The result is a stepback along what will be the entire top edge, or sheer, of the hull.

Cardboard templates. Make a set to check the vertical hull contours. Mark crosslines on both the top and bottom surfaces of each assembly at the check points, for quick and frequent reference.

Use half-round, flat, and rat-tail rasps and files to chew away the steps formed by the varying lift outlines. When the templates press snugly against the pattern surfaces at all check points, sand smooth and turn the units over, and drill holes for four aligning dowel pins.

Press the pattern sections together on

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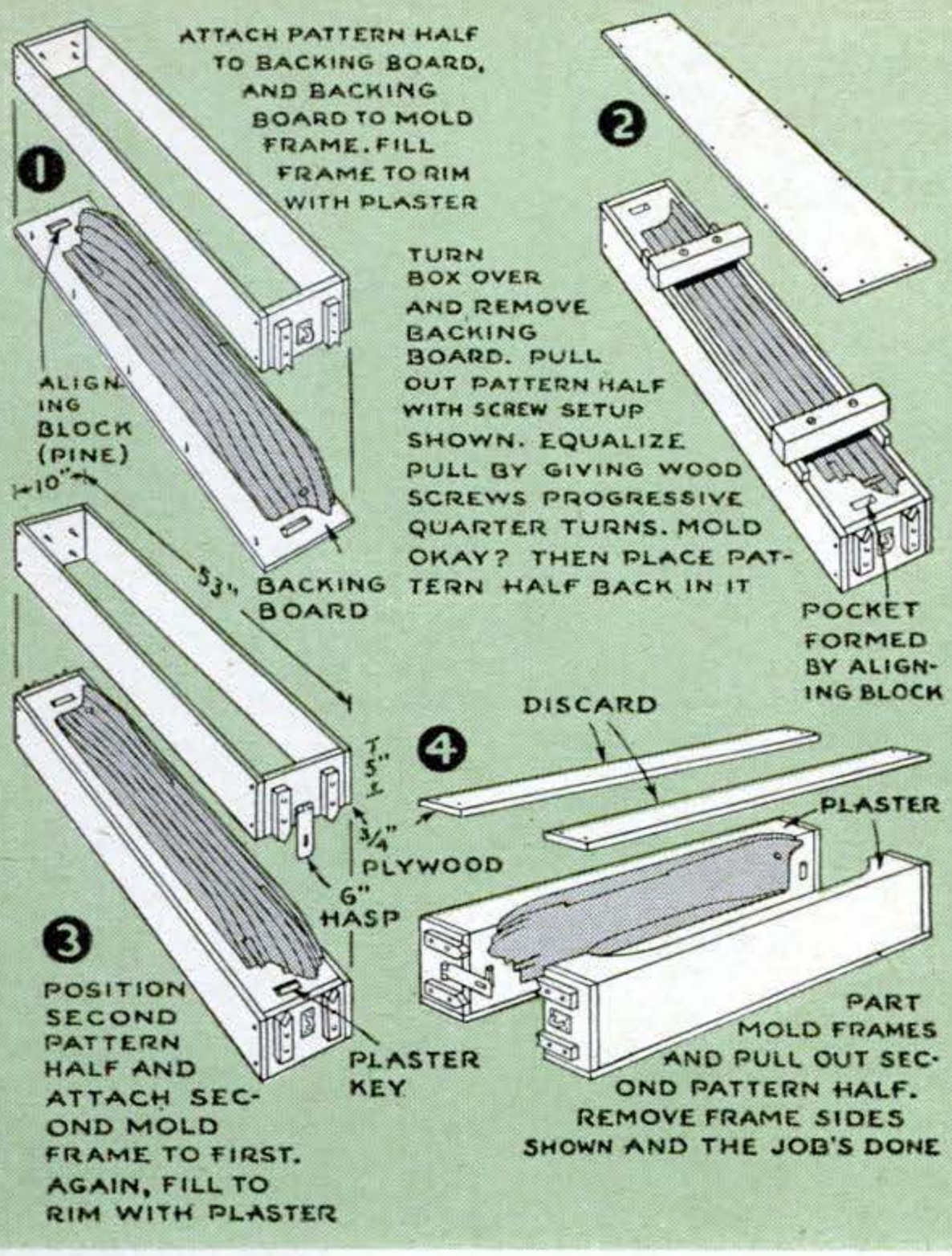

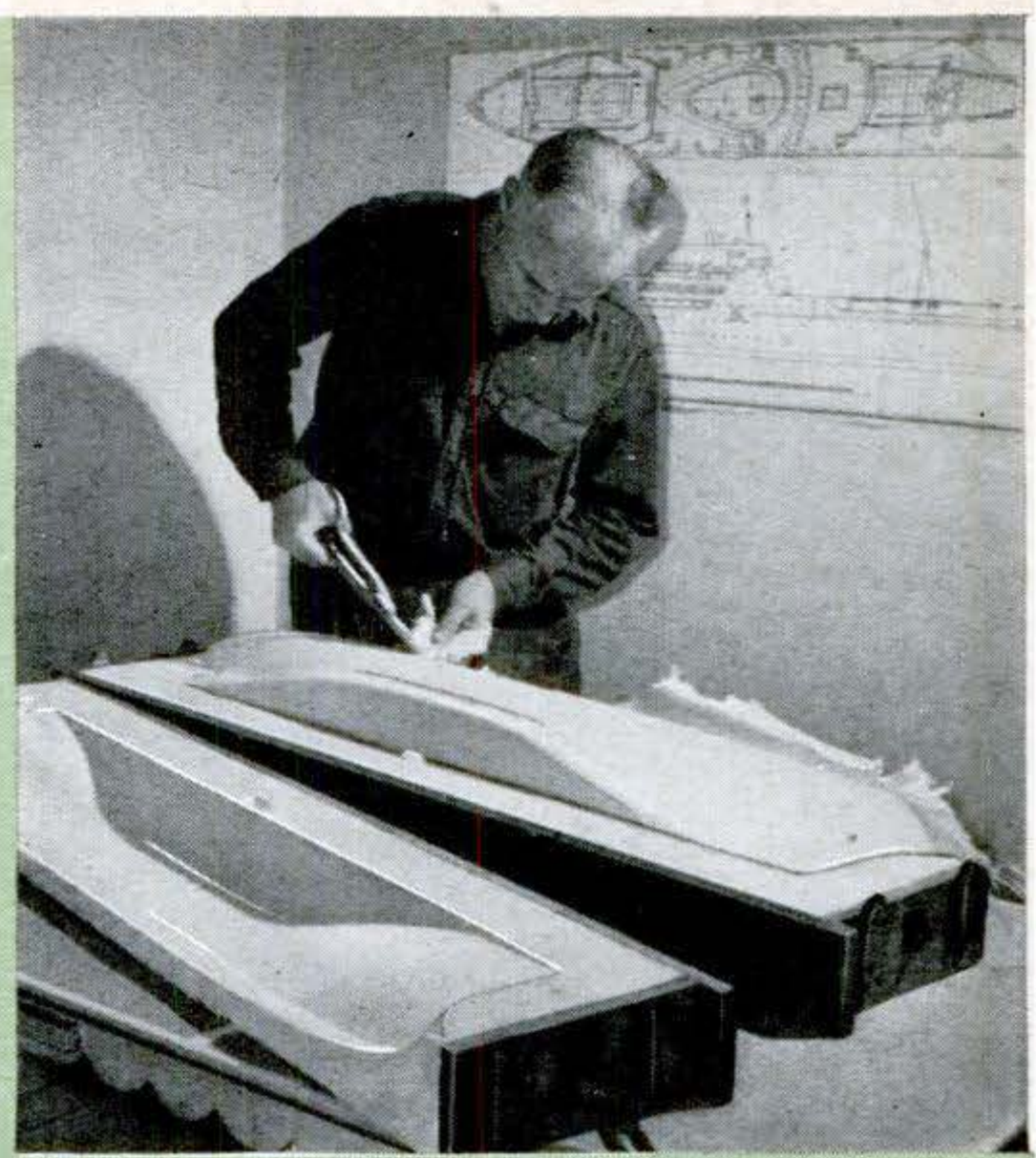

MOLD-MAKING PROCEDURE is outlined in the drawing at left. The finished two-piece mold is shown at 4. Spray the mold with white enamel, then grease it with cold cream to keep fiber-glass resin from sticking to it. Brush white resin into mold, lay fabric over it, and brush resin over fabric to create hull. Trim excess fabric at the sheer line as shown above.

these pins, and file the bow, stern, and bottom edges to a trim meet. While the halves are still assembled, drill a hole for the rudder-post bearing, and cut a long, tapered notch for the propeller-shaft housing. Then separate the pattern again, and glue in the bearing and housing sections. These are a halved dowel pin and a hardwood turning, respectively. Fillet the angles where they meet the hull with wood putty. Cut hawse-pipe rims and bilge keels (the strips on the sides of the hull below the water line) from hardboard. Round them to contour and apply with glue.

Now sand the pattern sections. While you're at it, give the lip at the hull's sheer line a slight bevel. This produces "draft," or a surface that prevents locking when you pull the pattern and subsequent castings from the mold. Finally, apply a wash coat of shellac (half alcohol), followed by two full-strength coats, each sanded lightly after drying.

Making the mold. This, again, is a two-section job. You'll need a large, four-sided plywood frame for each half, and a simple aligning and locking rig to hold the two frames together. You'll also need a single backing board for one of the pattern halves, and two small, beveled blocks for keys to index the two halves of the mold.

Drawings show you how to pour plaster of Paris into the mold boxes and withdraw the pattern halves after the material has set. Tips:

1. When you screw the first pattern section to the backing board, make sure

[Continued on page 224]

A Good Winter's Shopwork

. . . That's what lies ahead for those who want to start now producing a model Savannah. Four construction articles in POPULAR SCIENCE will set the pace:

This month: Building the hull.
Next month: The superstructure.
February: The steam turbine.
March: Radio control.

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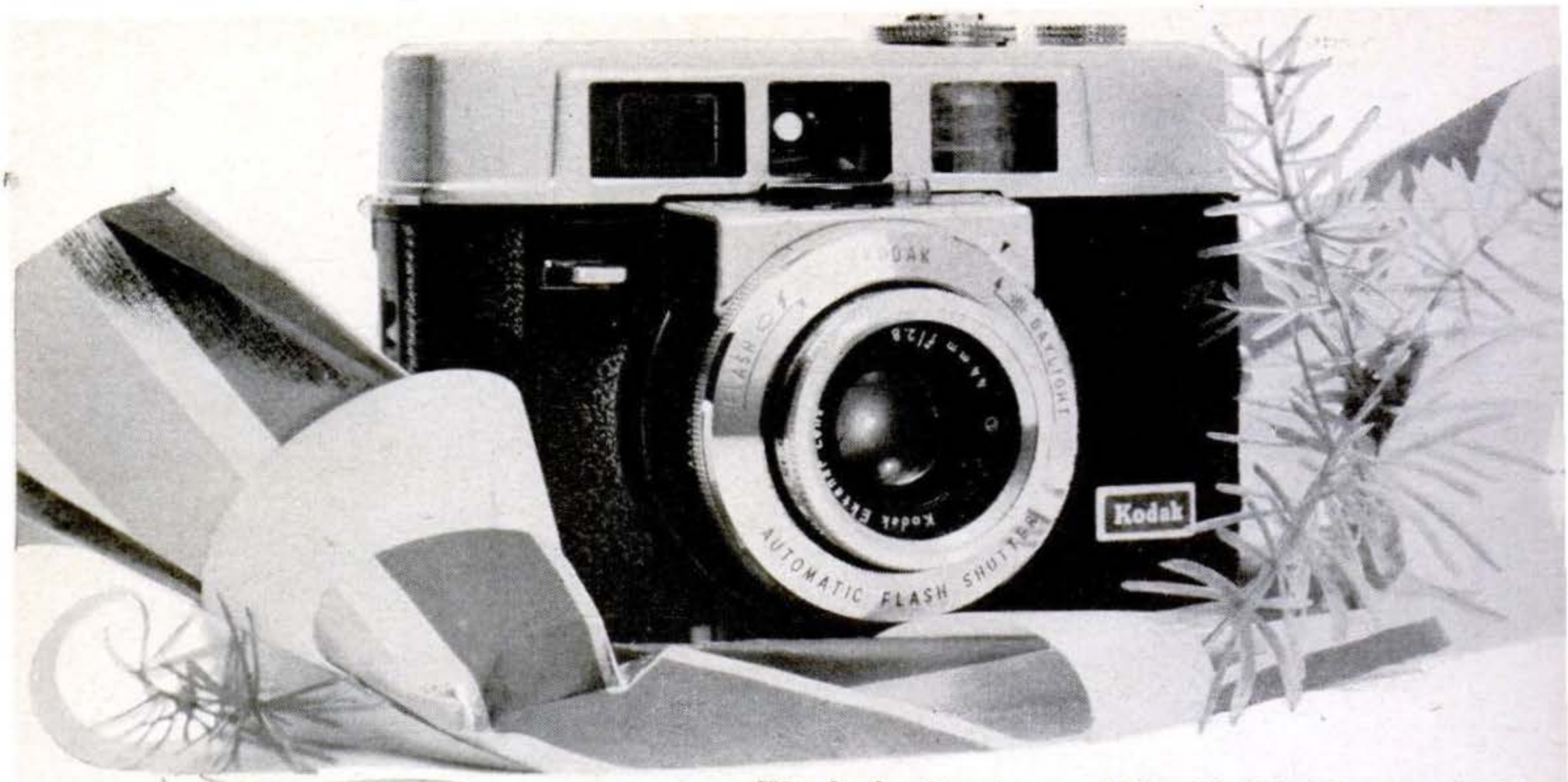
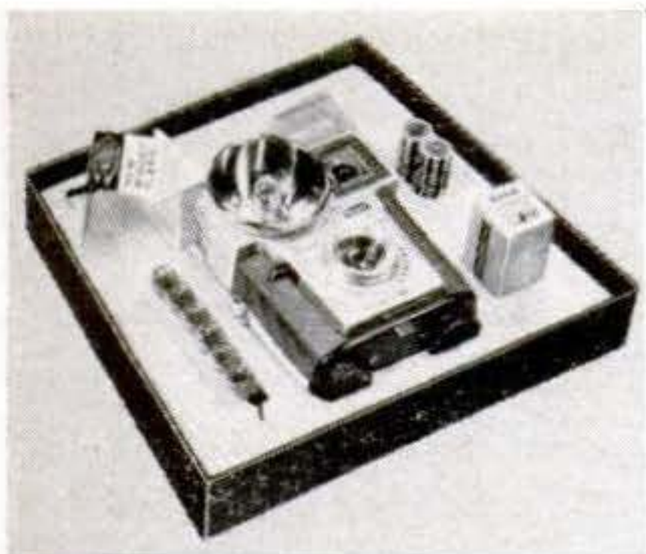


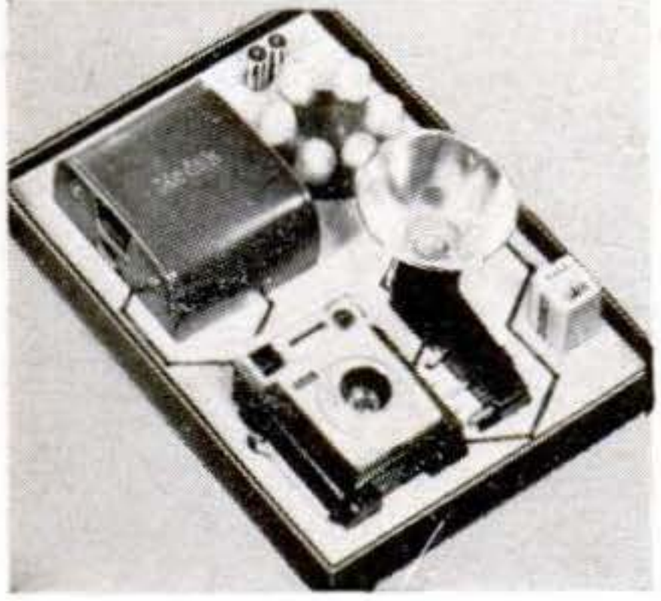
Winds the film for you! New Kodak Motormatic 35 Camera advances film automatically—sets exposure automatically, too . . . less than $110. Kodak Automatic 35 Camera . . . less than $90.

Kodak gifts say *Open me first!* because



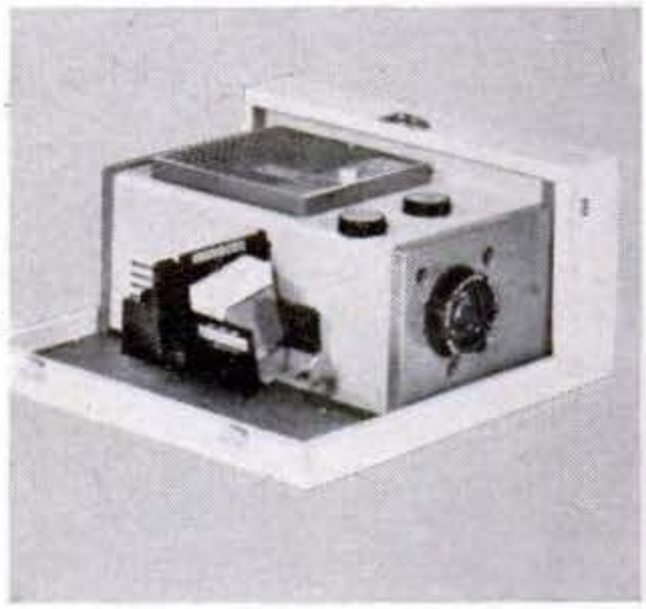
◀ ***Smallest Brownie flash camera!*** Brownie Starmite Camera with built-in flash gets sparkling pictures *any time.* Complete outfit . . . less than $12.

35mm precision—new ease! Kodak Retina Automatic III Camera gives you fully automatic exposure control and precision-coupled rangefinder . . . less than $130. ▶



◀ ***Sets its own lens!*** Brownie Starmatic Camera has built-in electric eye for automatic exposure settings. Complete outfit . . . less than $40.

For big, bright slide shows. Handsome new Kodak 500 Projector, Model B. Self-cased, only 11 pounds . . . from less than $68. Kodak Cavalcade Projector, Model 520, with zoom lens . . . less than $137. ▶



See your dealer for exact retail prices

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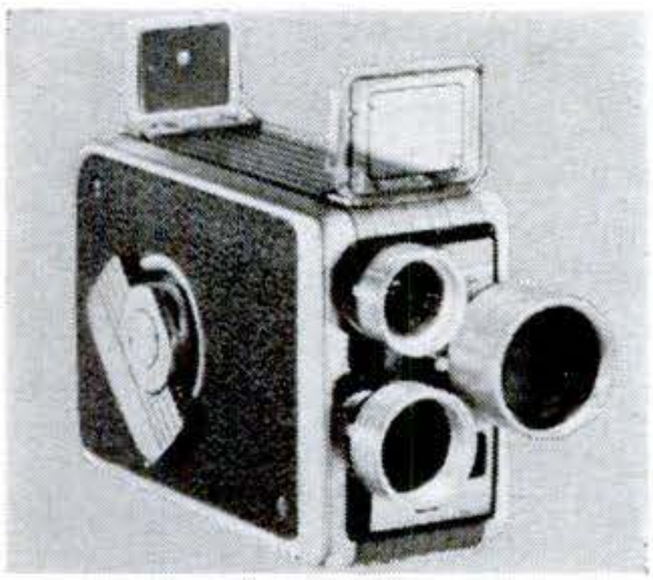
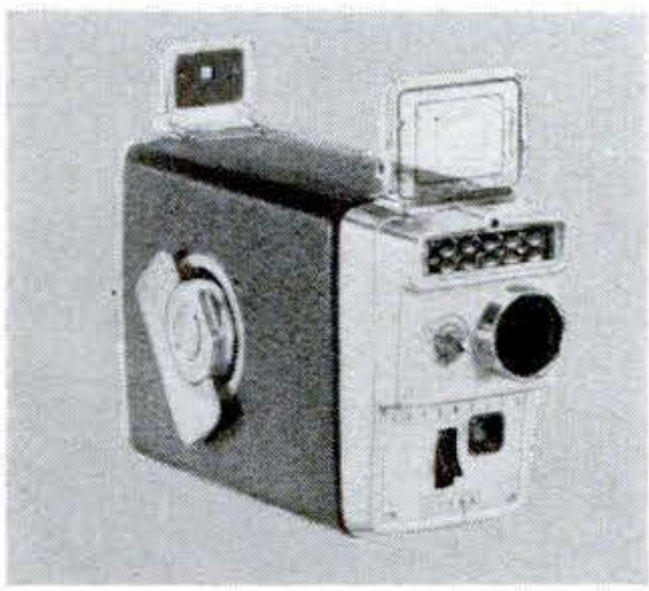
Zoom your movies with one finger! New 8mm Kodak Zoom 8 Reflex Camera lets you zoom up close with push-button ease. You view the zoom effect through the lens. Automatic exposure . . . less than $190.

you can picture all the fun of Christmas right from the very first moment!



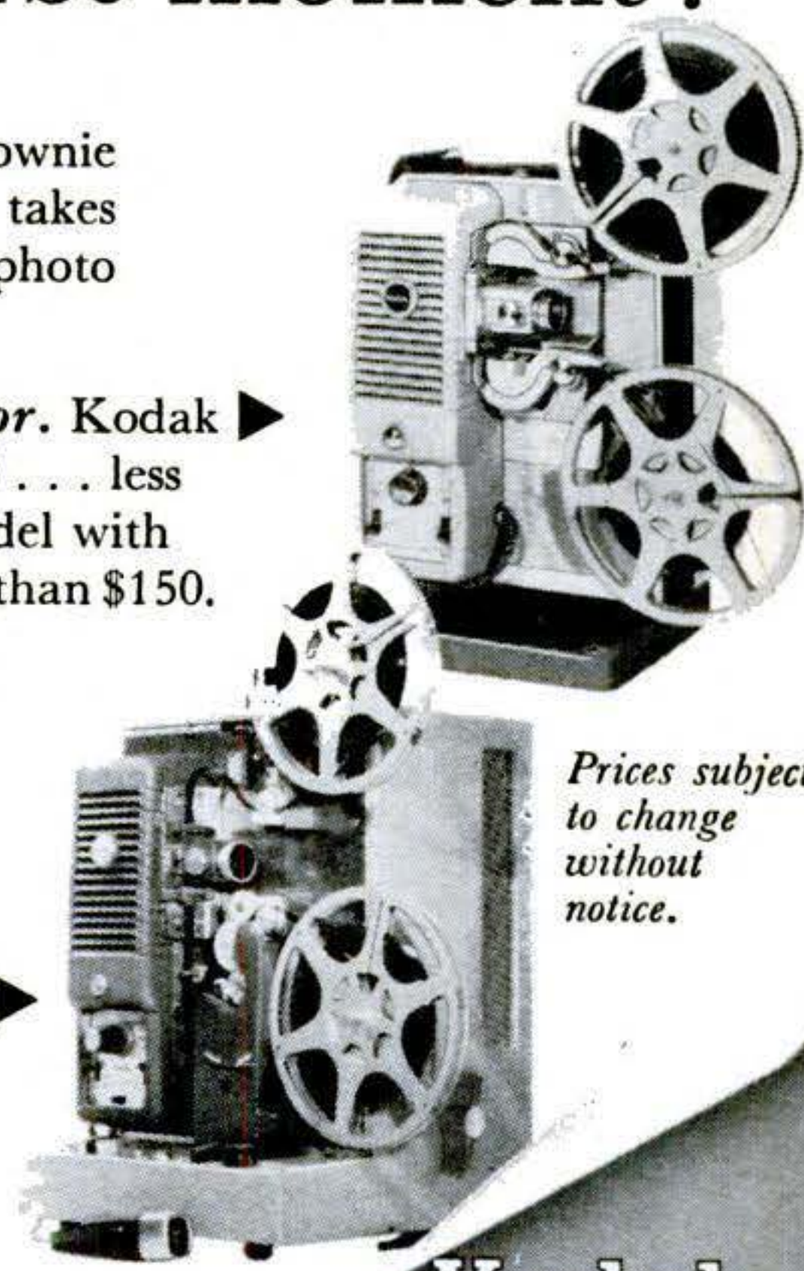
◀ ***Three 8mm cameras in one.*** Brownie Movie Camera, Turret *f*/1.9, takes wide-angle, regular, and telephoto shots . . . less than $60.

Fully automatic 8mm projector. Kodak Cine Showtime Projector, A20 . . . less than $125. Variable-speed model with Presstape Movie Splicer . . . less than $150. ▶



8mm movies—automatically! ◀ Brownie Automatic Movie Camera, *f*/2.3, has built-in electric eye that automatically sets lens . . . less than $78

Add quality sound to your 8mm movies! New Kodak Sound 8 Projector lets you add voices, music, sound effects . . . less than $350. ▶



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EASTMAN KODAK COMPANY, Rochester 4, N. Y.

See Kodak's "Ed Sullivan Show" and "Adventures of Ozzie and Harriet"

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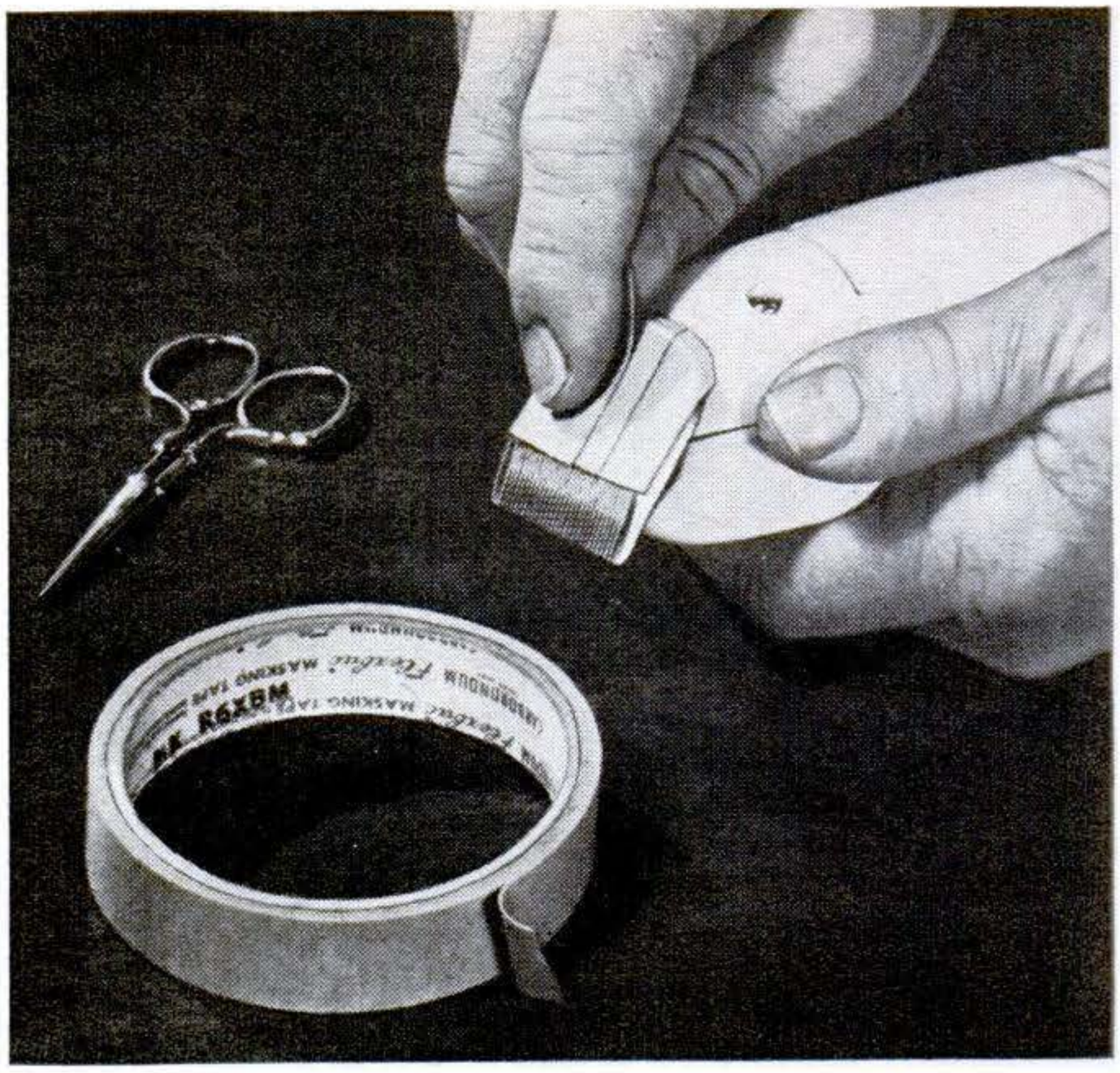
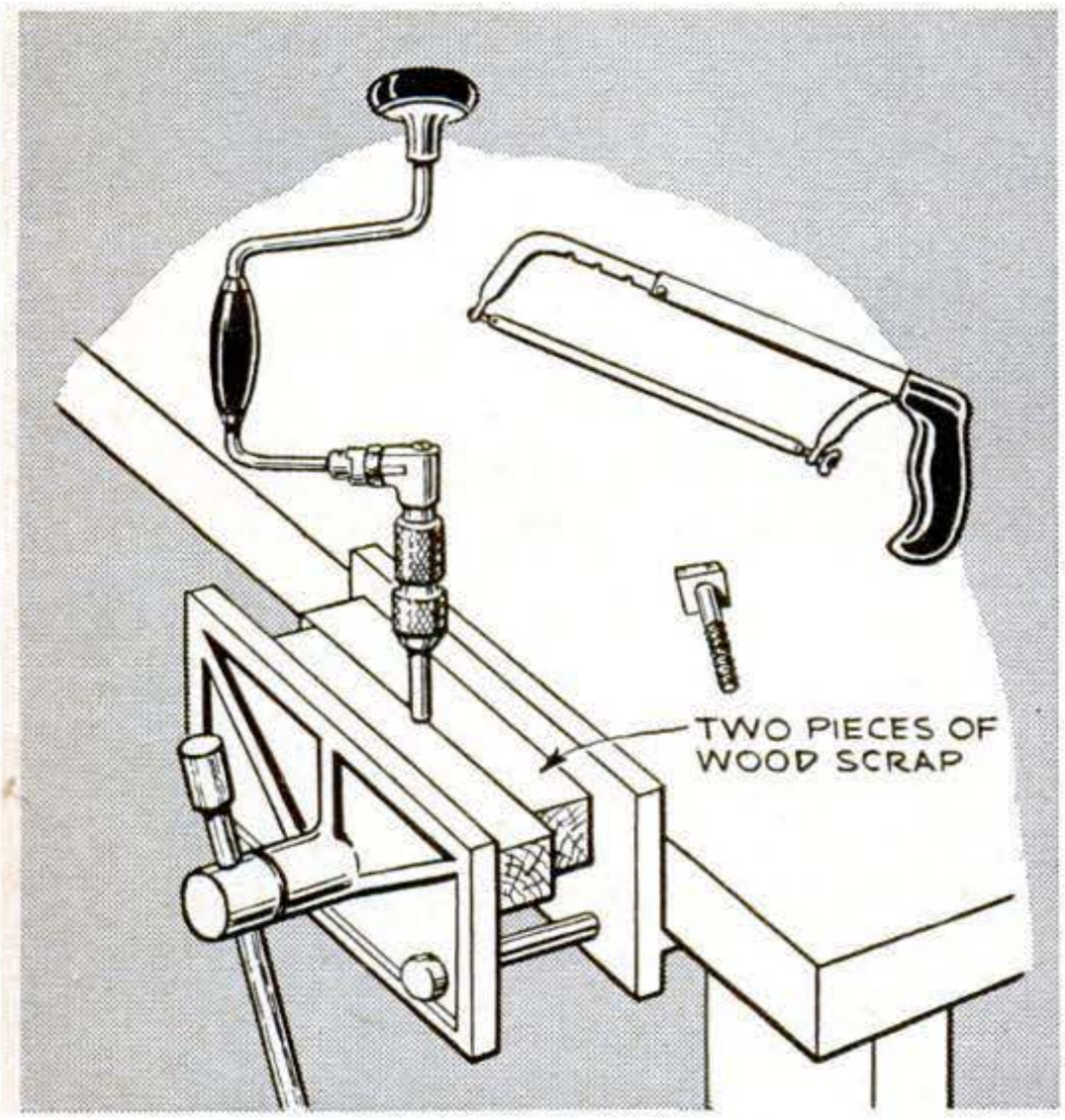
Short Cuts and Tips

FROM PS READERS

Tape Insulates Heated Clippers

HAS the price of haircuts turned you into a family barber? If you've more than one youngster to trim, you may find that the electric clippers heat up. To keep your second customer from jerking away from the hot metal, insulate the bottom cutter plate by covering it with a layer or two of masking tape.—*Edwin M. Love, Palmdale, Calif.*





Clamping Round Stock in a Vise

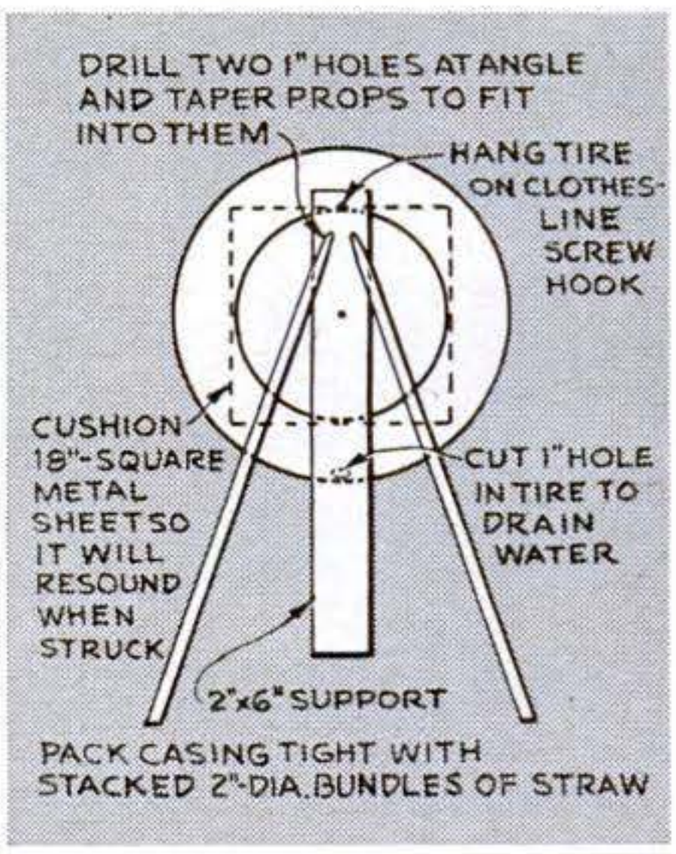
EVER try to hacksaw a bolt or short piece of rod while holding it in a vise? It usually loosens and twists, ruining the cut. Try this:

Slip two pieces of scrap wood about 1″ square between the vise jaws and draw them up tight. Choose a bit that's a size smaller than the bolt diameter, and drill a hole centered on the joint. Open the vise slightly, insert bolt, and retighten jaws.—*J. J. Mills, Battle Creek, Mich.*

▶▶▶HEAT drains quickly away if you hold items in a metal vise to solder them. This heat dissipation can be prevented by folding a scrap of asbestos paper around the item to insulate it from the vise jaws. —*Jim Purves, Peru, Ind.*

Archery Target from Old Tire

ARROWS bounce off the tire casing that rims this straw target. A better aim is rewarded with a gong, and a bull's eye rates a pop *and* a gong. A metal backing makes the gong; the pop comes from a 7″ square of vinyl shelf cloth stretched across a 6″ embroidery hoop wired to the straw.—*K. Johnson, Oceanside, N. Y.*



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Christmas Savings

DELTA HOME WORKSHOP SALE

on two of the most useful power tools you can own

Cat. No. 34-005 Delta Homecraft 9" Tilting Arbor Circular Saw equipped with Extension Wings and Steel Stand.

Take advantage of this special holiday offer on the Delta 9" Circular Saw. Ideal for starting (or improving) your workshop, it's the tool you'll use most often on any job—makes precision cutting faster and easier. So get big enjoyment and enjoy a big $22.05 savings*.

This new, improved Delta Dust Collector is really tops in versatility! It can be used with almost any woodworking power tool, adapted for paint spraying, general clean-up and a dozen other helpful jobs. To add more convenience to your shop, add this practical tool—you'll appreciate the practical $10.00 Christmas savings* you get.

Cat. No. 49-576 Delta Dust Collector complete with motor and hose.

**Prices and savings slightly higher in the West*

HURRY—OFFER LIMITED!

See your Delta Dealer (listed under "TOOLS" in the Yellow Pages) or visit leading Department, Hardware or Building Supply Stores. Rockwell Manufacturing Company, Delta Power Tool Division, 504M N. Lexington Ave., Pittsburgh 8, Pa.

DELTA POWER TOOLS

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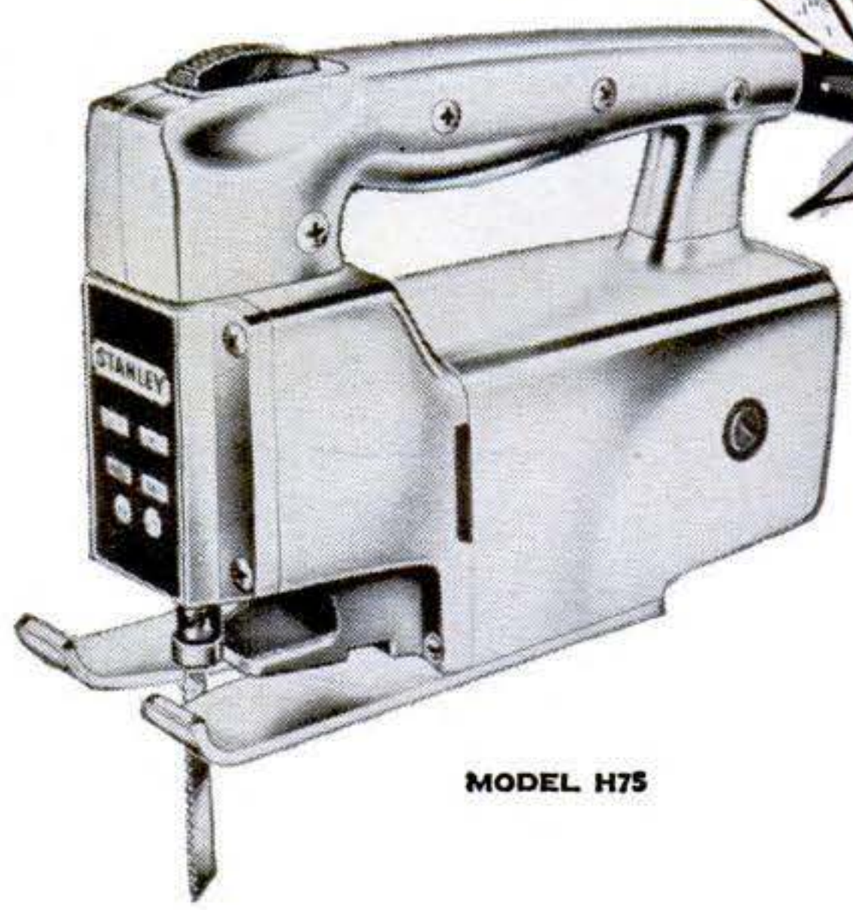
STANLEY

PSST . . . *Any gal can take a hint. "Hide" this ad in an obvious place—get the Stanley Christmas Special you want!*

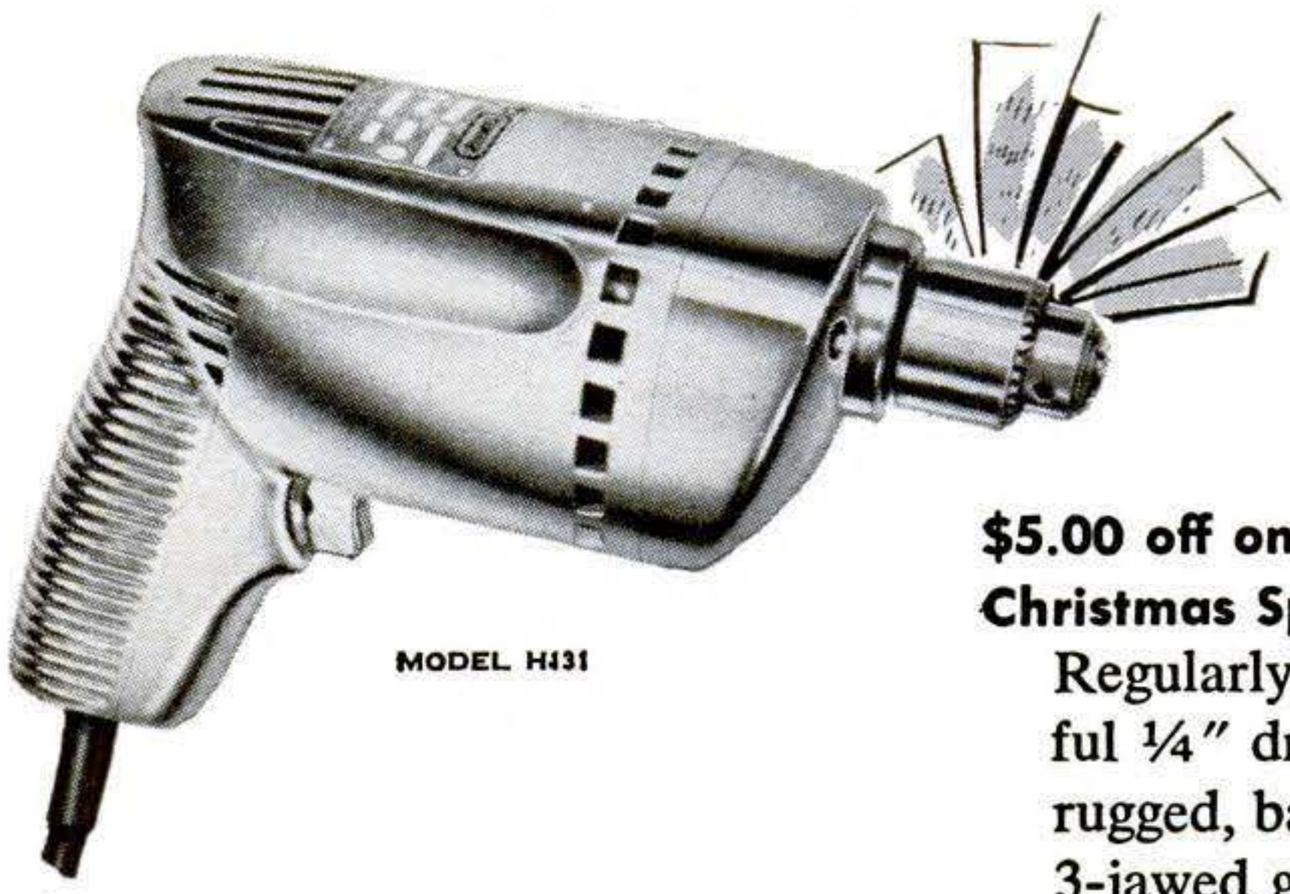
(Special offer ends Dec. 31, 1960.)

Heavy-duty sabre saw—only $46.95
PLUS 7 assorted blades worth $4.90—FREE!

Fastest selling heavy-duty sabre saw on the market! Cuts scrolls, curves, wood, metal. Special blades cut flush up to a wall and to ⅝ of an inch along a wall.



MODEL H75



MODEL H131

$5.00 off on 3-amp ¼-inch drill!
Christmas Special: only $19.95

Regularly priced at $24.95, here's the most powerful ¼″ drill for the price on the market. Features rugged, balanced construction, non-slip pistol grip, 3-jawed geared chuck, 3-wire cord.

Electric tools built for the professional.

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Christmas Specials

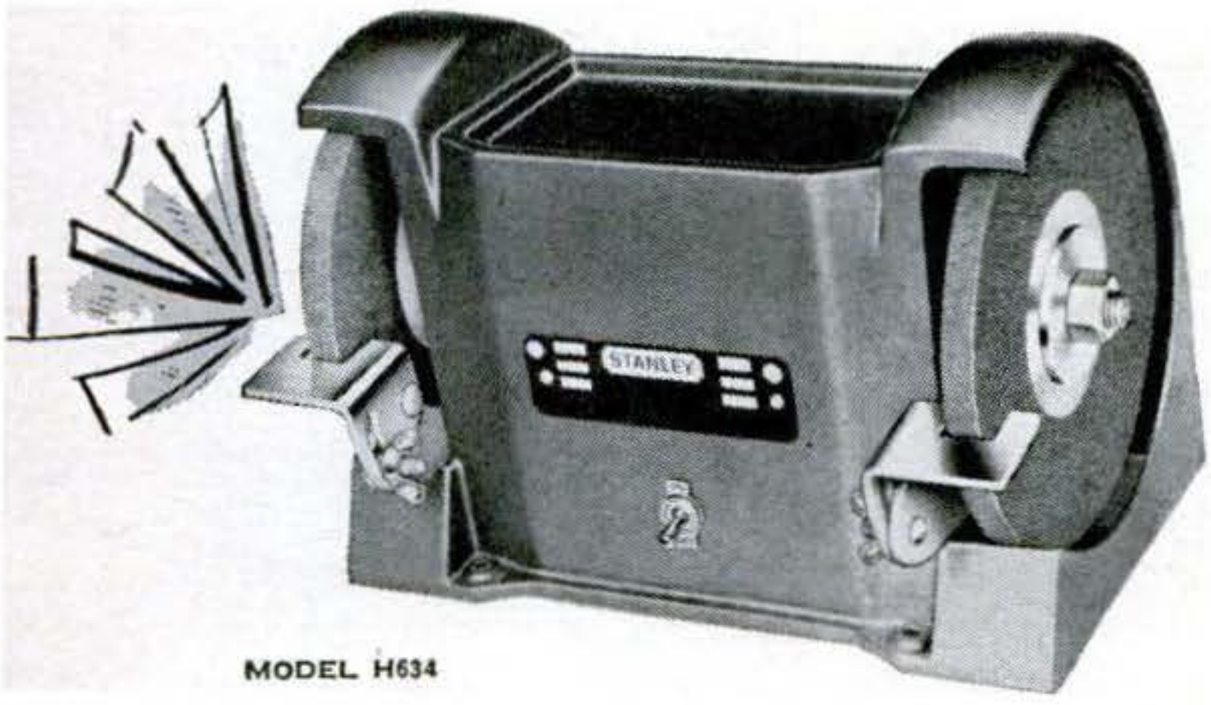
MODEL H37

Circle the Stanley Christmas Special(s) you want— then cut out this ad and leave it where it will do the most good!

NEW! Finishing sander . . . only $34.95
PLUS—2 packs of sanding sheets . . . FREE!
Sands and fine-finishes table tops, cabinets, bookcases and many other kinds of furniture. Ideal for small work areas.

MODEL H268

Heavy-duty builders saw—now $54.95
PLUS—$2.65 combination rip/crosscut blade . . . FREE!
This 6½″ saw lets you tackle any cutting job . . . a breezeway, porch, playroom, fence! Features rear controls; exclusive "free-start" blade guard that never jams.



MODEL H634

NEW! Bench grinder . . . only $46.95
special introductory price! Reg. $49.95.
You save $3.00 and get two grinding wheels and two special tool rests, too! ¼ hp, general purpose grinder. Perfect for sharpening tools, skates, removing rust—a "must" in your workshop!

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priced for everyone

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[Continued from page 112]

Yellowstone Park for 12 years and in the Park Service there for 25.

During those years, he got to recognize many individual grizzlies. Some of them, he discovered, wander 50 miles or more in their travels. An occasional one strays out of Yellowstone or Glacier and gets shot.

Barring such accidents, disease, and fatal fights, the average grizzly lives 18 to 20 years, it is believed.

How smart are they? Grizzlies don't look very bright. Their piglike eyes are set in broad, square faces, topped by ears that seem too small for them. Appearance doesn't belie them. Good eyes, sharp ears, and keen noses serve them better than their wits, Condon thinks.

Are grizzlies nearsighted, as used to be thought? Not so, says Condon. Robert McIntyre agrees with him.

Late last winter, McIntyre and a lone grizzly stalked each other, a mile apart, along opposite banks of the Yellowstone River. The wind was from the bear's direction, the snow soft and deep. McIntyre was on snowshoes. It was impossible for the bear to have caught his scent or heard him move. Yet every time he looked at the animal through his field glasses, he found the grizzly staring at him.

Tiring after two hours, the bear curled up in the snow and went to sleep.

The bill of fare. Though the grizzly will gobble almost anything edible, Condon says, he prefers grass, herbaceous plants, fruit, and acorns. He also likes roots, ants, honey, and ground squirrels. He digs out the last with those ideal implements—extra-long claws. Like all bears, he is adept at fishing, too. Only in the spring, when he is leanest and hungriest, after a winter devoted largely to wary rest, does he seem to have a taste for flesh. That is when he is most likely to attack elk, deer, and moose.

Do grizzlies have any desire for human flesh? There is no evidence to support this, according to those who know the bears best.

"If grizzlies really hated people, there would be many more casualties," Condon says. He is convinced that in most cases where grizzlies have attacked people, they were either fighting in self-defense —or thought they were.

Still, the big brutes do have ingratiating ways, says Condon, who has a very soft spot in his heart for them.

He once saw a female grizzly obligingly baby-sit with 17 cubs while their mothers joined the males at feeding.

He has seen adult grizzlies play like kittens and repeatedly slide down snow banks on their big, fat rumps, with as much obvious delight as frisking kids.

Another time, while Condon watched with amusement through binoculars, a full-grown male grizzly pretended for long minutes that he was a cub again. First he would dash around in circles, as if chasing a ghostly comrade, then sit and shadow-box. He concluded his private lark with a series of somersaults.

Condon retains his affection for grizzlies even after coming within a couple of inches of being mauled and possibly killed by one.

He was with a movie cameraman, trying to take close-ups of an orphan cub. The men got out of their station wagon in a remote area of Yellowstone and followed the cub up a dirt road. They ended up uncomfortably far from the car.

Trouble coming. As they turned back, Condon noticed a massive grizzly headed straight for them across a billowy pasture. The bear was still a long way off, but Condon and his companion started to move faster. Soon the bear was approaching at a dead run.

The cameraman was nearest the car, and on a downgrade, so Condon yelled to him to make a dash for it. He was sure he couldn't reach the car in time himself, so he stood stock still.

The grizzly came thundering up. At the last moment, Condon jumped sideways and ran toward the station wagon. The bear slid past, wheeled, and tore after him. In front of the station wagon, the bear hesitated just long enough for Condon to bolt into it on the far side.

Later the cameraman told him that as the bear had closed in, he had made a couple of furious swipes at Condon's fleeing back, each time missing by only a claw's length.

"He didn't try to break in the wagon, though," Condon recalled. "Just gave me a dirty look and strolled away. I think he wasn't so much trying to attack me as to show who was boss."

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[Continued from page 149]

write to Eastman Kodak, Rochester, N. Y., for suppliers near you.)

You'll also need a red bulb or a red filter for a safelight. Kodak recommends a Wratten Series 1A filter over a 15-watt bulb. The safelight can be used during both exposure and development without danger of fogging the film.

Cropping your pictures. Most 2¼"-by-2¼" negatives, and many larger ones, can easily be trimmed down to slide size without serious loss of picture area. Often you actually improve composition by eliminating poor or unneeded parts of the picture.

Check your projector. If it will take superslides, as most machines now will, you'll do well to use this size; it gives you more picture area than 35-mm. slides. Superslide mounts for transparencies are the same size on the outside as 35-mm. slides, but have a larger inside area (1⅝" by 1⅝").

On negatives too large to crop easily, you'll often find a small portion that will make an interesting slide, such as a close-up of a single face. Some enlargers with a long bellows draw can be used to reduce a large negative without loss.

Exposing the film. You can do this in several ways. An enlarger can be used as a light source, with the film and negative to be copied placed under the lens. This isn't necessary, however. A small, inexpensive contact printer works fine, and the process is exactly the same as for making paper prints.

For the ultimate in simplicity, you can even place the negative and film under glass and flash the setup with a 15-watt light bulb held a few feet away. It's not as easy, however, to obtain precise exposures this way.

Whichever method you use, both films are placed flat together, with the emulsion (dull) side of the negative facing the emulsion (dull) side of the positive film. If you use an enlarger the negative should be placed on top of the film and covered with a sheet of glass. With a contact printer, the negative is placed under the film against the printer's glass.

On small negatives, it's best to cut the film slightly oversize and trim it to fit the slide mount later. On large negatives, you'll save film if you cut it first so it covers only the part of the negative used.

Exposure times vary. The type of light you use and the density of the negatives to be printed will affect your exposure time. Using an enlarger light, with lens closed down to f/18, I found that an exposure of six seconds proved about right for negatives of normal density, but the exact time should be worked out on your own equipment. As a guide to speed, Kodak says its positive film is about half as fast as Kodabromide paper No. 2.

When you use a contact printer, the light must be reduced, since the film is much faster than contact paper. This can be done by switching to a small 7½-watt bulb and covering it with several layers of paper. With three layers of heavy white paper, you get an exposure of about two seconds.

Developing the film. You can use ordinary paper developers. Kodak recommends Dektol (1:2), Versatol (1:3), or D-72 (1:2). The average development time is 3 to 3½ minutes at 68 degrees F. with continuous agitation. Low-contrast prints can be strengthened by shortening the exposure time and increasing the development time.

Rinsing takes about 30 seconds in short stop or plain water. Follow this with a 5-to-10-minute bath in acid fixer, agitating the film frequently. The finished transparencies should then be washed for 20 to 30 minutes in running water. A wetting agent after washing helps the film dry without streaks.

It's important to keep both film and negatives as clean as possible. Dust spots that are invisible on prints become golf balls when you project them.

Mounting the slides. Various sizes of cardboard mounts are available. You simply slip the film into them and seal the edges with the tip of a hot iron.

For all negatives in the 127 size or larger, use the 1⅝"-by-1⅝" superslide mount, which gives you the greatest image area. If you have 828-size negatives, you can get a special mount to fit them without cropping them down to the 35-mm. size. Use 35-mm. mounts only if you're printing 35-mm. negatives.

Ready for a thrill? Wait till you see those old-time, dusty, dogeared memories pop into brilliant life on your screen.

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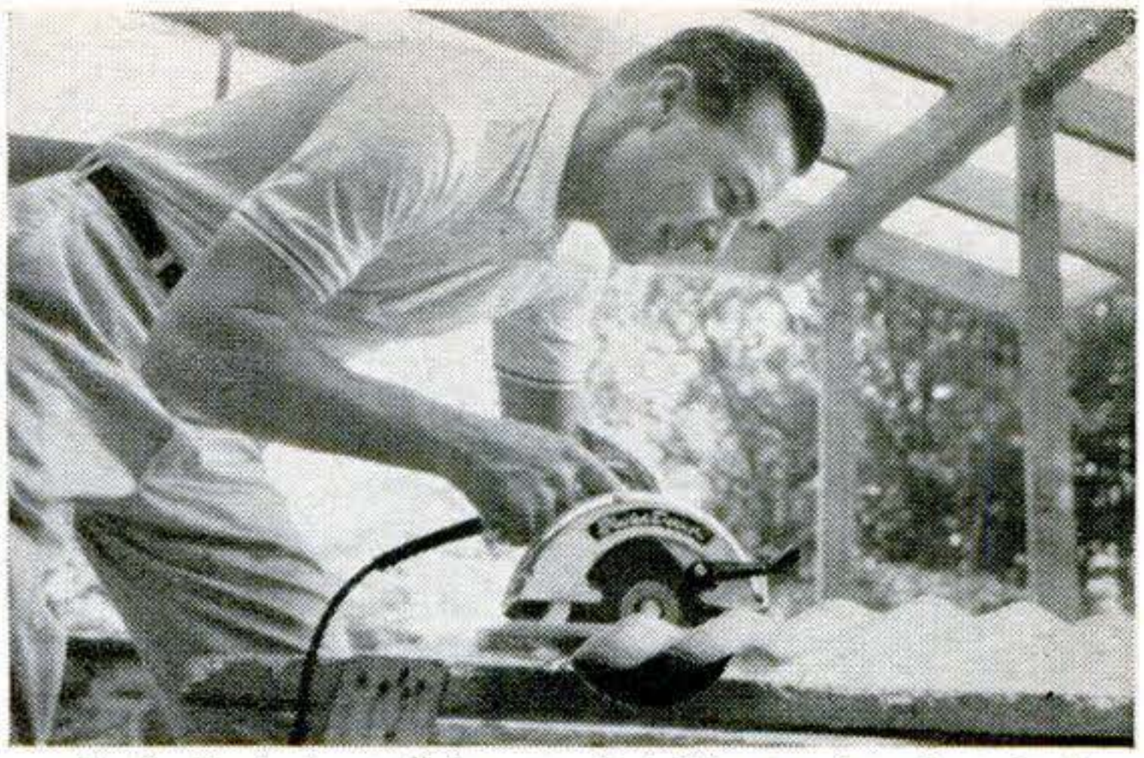
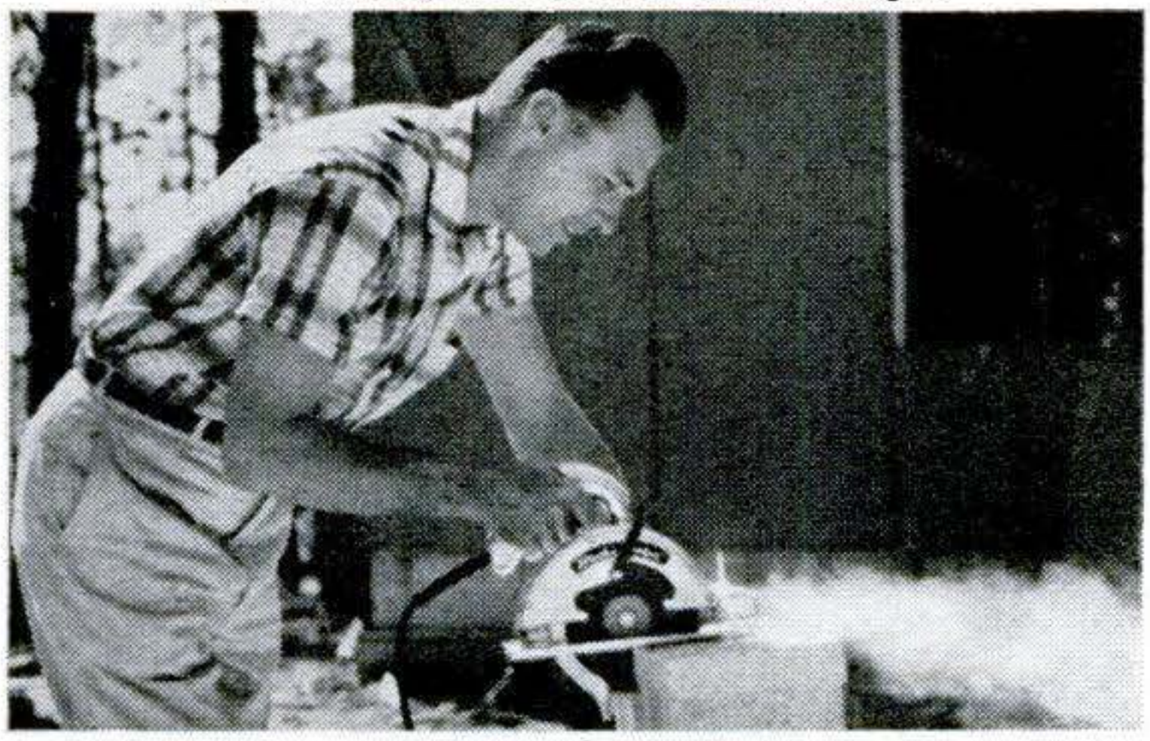
Races through 2x8's even at 45° angle



Perfectly balanced for comfortable one hand control



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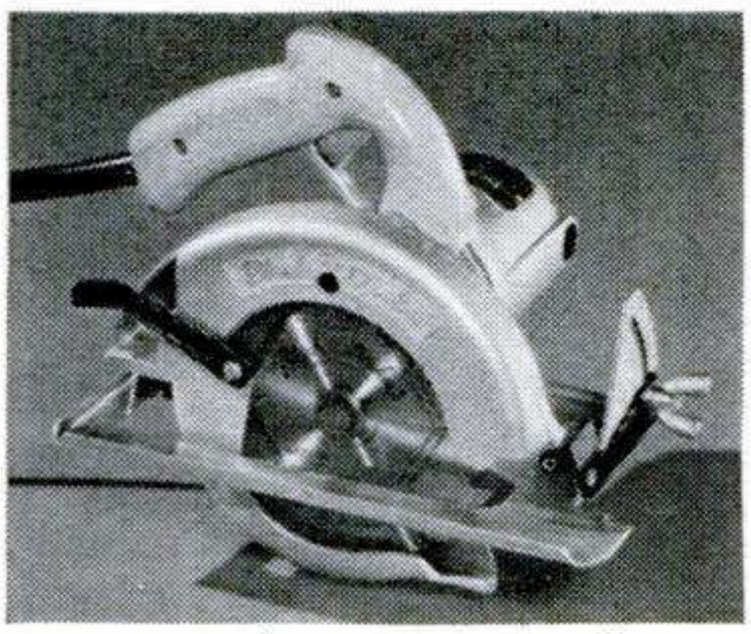
Famous B&D dependability, prized on top construction jobs



NEW B&D #437 Utility 7¼" Saw. Extra capacity and power in an economically priced 7¼" Saw Complete adjustment for cutting-depth and bevel sawing up to 45°

B&D #63 Heavy-Duty 6½" Saw. Famous B&D built motor. Tough, durable, yet a doll to handle. Professional features and performance make it the choice of the experts.

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You'll like the versatility and power of B&D Saws. They're built to take it . . . to do a full *day's* work, *every* day, *all* year. Built to respond with trigger-quick action for fast, precision, swerve-free cutting. Famous B&D dependability keeps work moving at a fast pace.

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WORLD'S LARGEST MAKER OF POWER TOOLS

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[Continued from page 159]

the edges for climbing. Low-slung, speedy racers were made of film spools.

Celluloid comebacks. Brightly colored, these were sold as nursery toys, and no growing boy would play with them. But if you made your own, it was all right. We built them of any round container with a detachable lid—today's coffee cans are ideal. When we rolled the thing away, rubber bands with a pendant weight between them would wind up. On unwinding, they'd roll the can right back.

If you rolled it too hard, or let it hit something, momentum would swing the weight over center, the innards would go *twang,* and the bands would unwind with a standing tremor. So the game was to see how far we could roll it for a successful return—and to mystify kids not in on the secret.

While the experts were saying that the helicopter would never fly, we had great fun with tin propellers threaded on a spiral stick. These we bought for a few cents. When you pushed the prop off the stick, it took off spinning.

But once the stick was lost or bent, we'd punch two holes in the prop, outside its centered slot, and rig a spool to turn on a vertical shaft or handle. After winding cord on the spool, we set the prop holes over two headless nails in the top of the spool, angled it away from us, and yanked the cord.

These props would sail four or five stories high at times. For duration flights, we'd flatten the blade angle. The prop would skim at barely head height, but stay aloft much longer.

Plain paper, too. This also had possibilities for fun. We folded it into dartlike gliders, play hats, boats that sailed until soggy, and noisemakers. Another dandy flying toy was what I call the twirly-chute, a take-off from winged maple seeds. When Dad took us to his office, we'd toss dozens of these from an eighth-floor fire escape. Updrafts between the buildings often carried them up higher, sometimes out of sight.

For a button whizzer, you had to wangle the biggest button in Mother's sewing box and thread thin, tough cord through two of its holes. Hooking a finger into each end of the doubled cord, you swung the button around to put twists in the cord, then pulled the ends apart hard. This spun the button; you learned to slacken the cord as the twists ran out, so that the spinning button rewound it the other way, and so on until fingers were raw.

Cardboard disks were even better than buttons; sometimes we cut slits in the edge. At high speeds, the disks made sirenlike buzzes.

Four equal lengths of cord tied to the corners of a handkerchief and a weight made chutable parachutes. One way to throw them high was to grab the center of the handkerchief and whirl the weight around, letting go on an upswing. Another way was to roll the chute around its weight and hurl it with a slingshot.

Whistles. Real straws made fine ones of a simple kind, but we city kids had to use those from soda fountains. We flattened an end well into the mouth so that neither tongue nor lips touched it. Some whistles required hard blowing, others would sound off only if gently blown.

If one didn't work, it was easy to snip half an inch at a time off the outer ends; at each snip the pitch went up. We made flutes of a sort by snipping holes at inch intervals down the straw, but could never quite tune them. Sometimes we tied three or four whistles together. Blowing all at once created chords of delightful dissonance.

Most ingenious of these folk toys was a spring clothespin gun dreamed up by some inspired tinkerer. You took it apart, removed the spring, and put it back on one wooden half with the coil backwards.

Washers, pebbles, or peas were laid in front of the cocked spring. When you pulled the trigger, such ammunition was shot forth on a rather unpredictable path.

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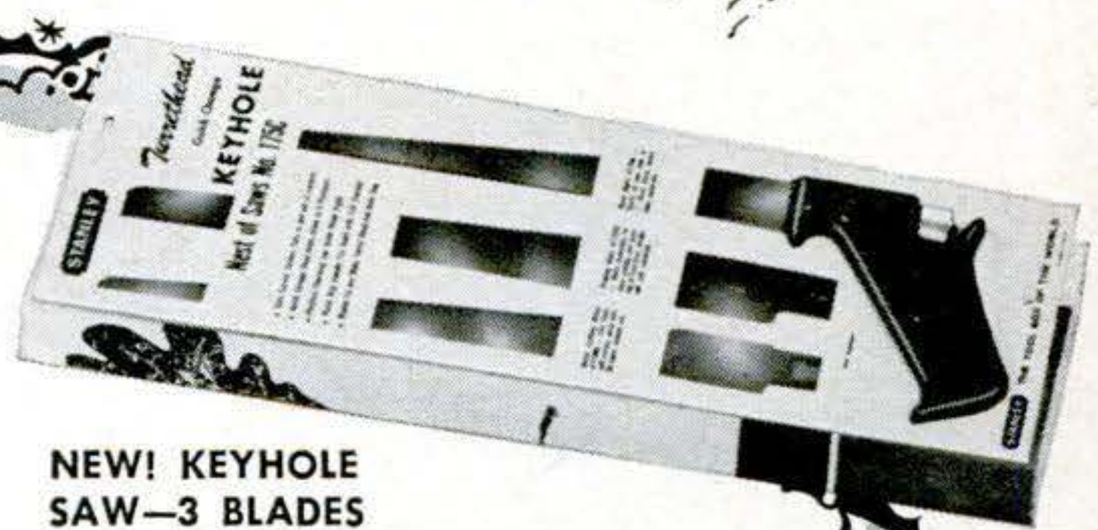

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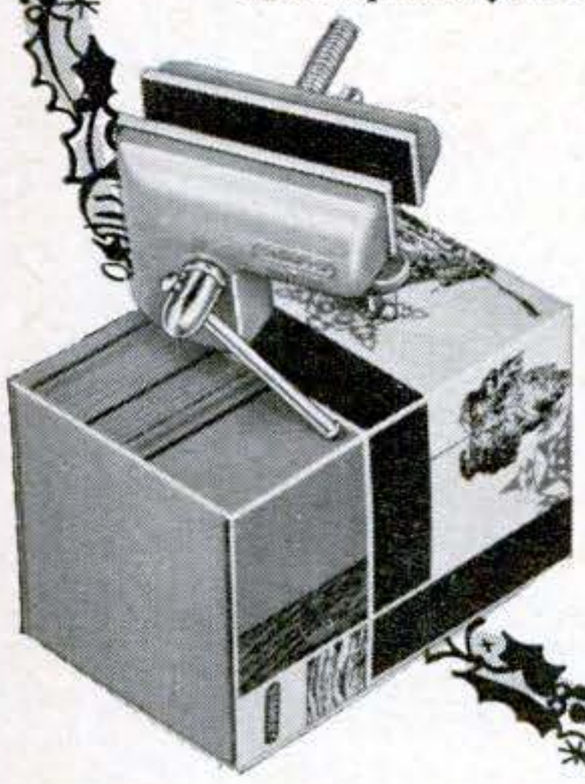

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A. O. SMITH CORPORATION — Welding Products Division, Milwaukee 1, Wisconsin

Agena: Prize Performer in Space

[Continued from page 119]

The Bell engine is mounted in gimbals, so it can be swiveled for steering either Agena A or the more versatile Agena B, to be used for Midas, Samos, Nimbus, and various space probes.

Although the rockets are essentially the same, the somewhat longer B models can be restarted in flight.

It took special ingenuity to make this feat possible. In space, Agena's fuels are, of course, weightless and may be almost anywhere in their tanks. They ignite on contact in the combustion chamber, but turbopumps must first be able to get at them and pull them into it.

How will it be done? Small solid rocket charges will generate gas to spin the pumps' tiny turbines. Then a couple of other little rockets will give Agena a bit of a shove forward, to force the fuels to the rear of their tanks and within reach of the pumps.

Agena B will also carry more fuel than the A model does. This is a great advantage. Agena A, boosted by Thor, can carry about 1,700 pounds into a 200-mile-high orbit. Agena B, boosted by Atlas, will be able to send 5,300 pounds into at least a 300-mile-high orbit.

Frosting on the cake. Our early lunar probes missed their target by a space-cat's whisker. If they had been equipped with an engine that could be restarted and steered, their courses could have been corrected. Agena B can do both. When Ranger-Agena blasts off, it will have greatly improved odds for hitting its lunar target.

Next Month: "High-Speed Math" —$6.95 Book Condensation

Now PS shows you how to be a whiz at figures: do simple problems in your head, tough ones by writing down an astonishingly few numbers. Here are samples of problems that you learn to do—mentally—in seconds:

- ***How much is 51% of $81.30?***
- ***How much does a workman earn in 39 hours at $1.24 an hour?***

If you can't do them simply and easily, without a pencil, read January Popular Science.

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[*Continued from page 194*]

officer—a demolition specialist—described what had happened.

"When I turned on the TV, a slow popping noise like an outboard motor began. It grew in loudness and frequency. I shut it off, removed it to an open space, and secured it before it detonated." He stood there as if waiting a citation.

"Very well done, sir," I said humbly. "Is there a way to get juice to the TV?"

"I have made arrangements," he said, pointing to an extension cord.

I plugged in the set and turned it on. A loud popping noise began. The neighbors drew back. I switched off the set. I leaned against the locker—and recoiled fast. The metal was hot as blazes from the sun.

I fished through my tube caddy and brought out a new 6J6 tube (the type used for the mixer-oscillator in his particular TV). I was fairly sure the motorboating I had heard was caused by it.

An oscillator is a little like an engine that can run at different speeds. It runs at a different frequency for each channel. If something goes wrong, it may not get up to a speed even approaching the proper TV frequencies. It may run so slow you can hear it from the speaker.

I could really feel the heat under that cabinet as I started to replace the 6J6. The officer said, "You're wasting time fiddling with those little tubes. That picture tube is going to explode. It looked dangerous to me when I installed it last week, so I put on those steel straps."

I turned on the set. The popping noise was gone. The explosives expert leaped into action, dragged me back, and dropped the locker over the TV.

I was a little ruffled. "Take it easy. The TV's not going to explode. It was only a faulty oscillator."

"Wrong," he snapped. "Stand clear."

A muffled explosion sounded. He lifted the cabinet. The picture tube had imploded.

I looked over the remains. That new steel strapping had been made too tight. High temperature under the locker had made the glass picture-tube envelope expand. With no place to go—*whammo*.

I mentally awarded the lieutenant the Order of the Lead-Solder Cross as I loaded the wrecked TV into my truck.

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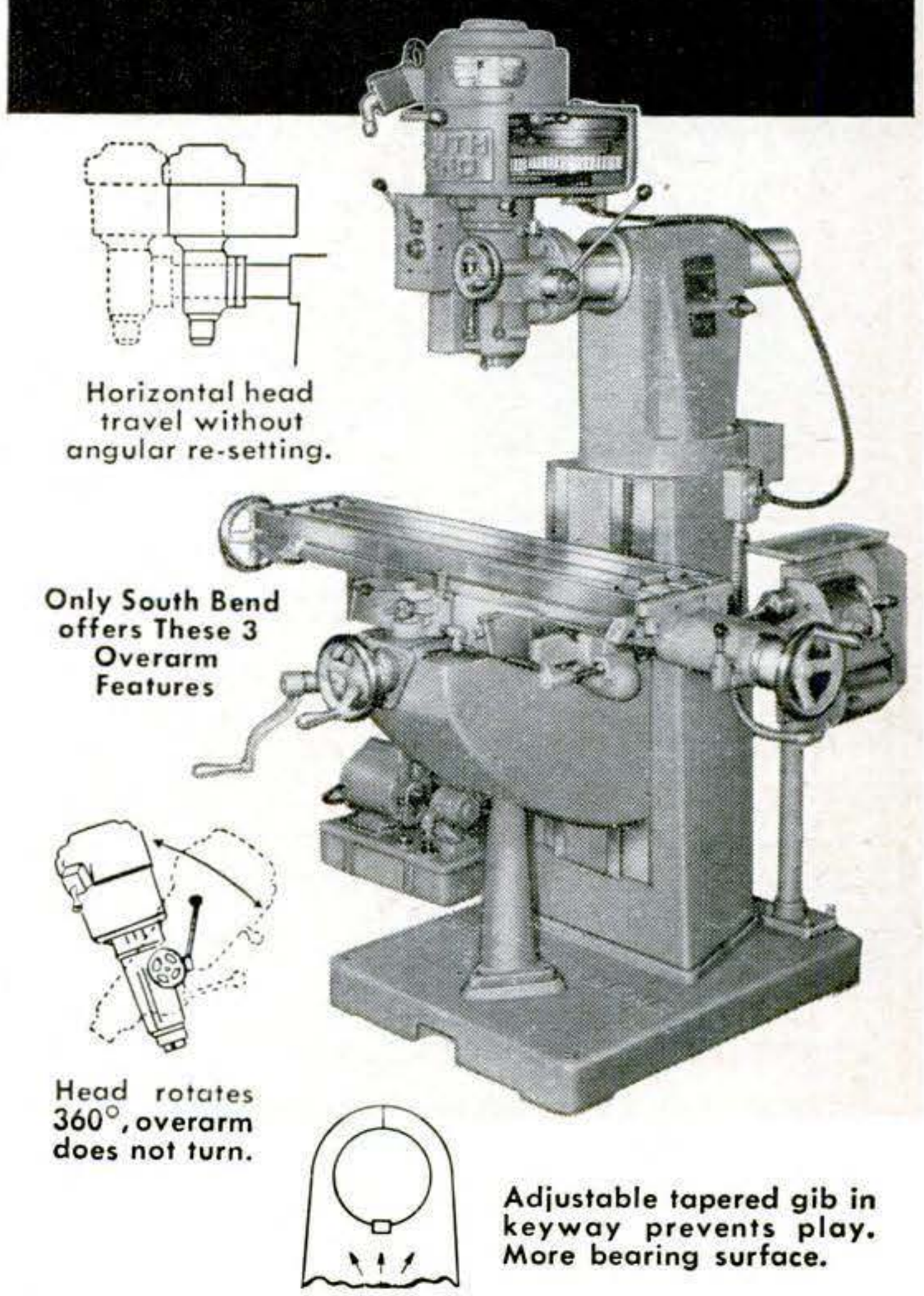

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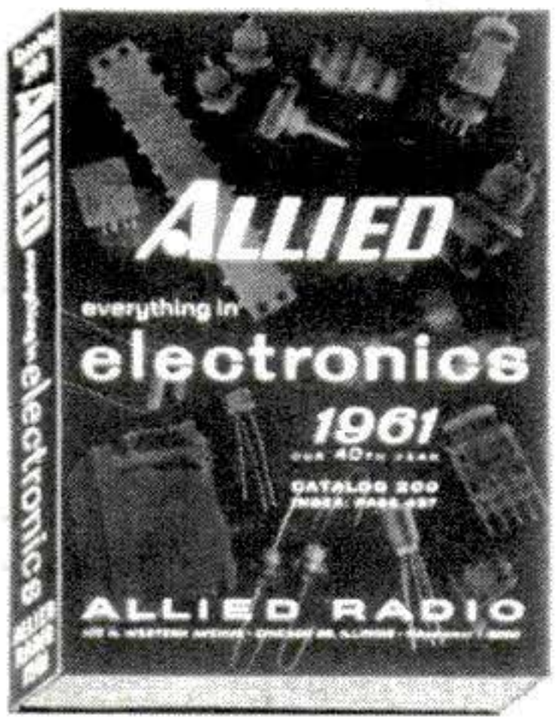

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How Pickpockets Pick Pockets

[*Continued from page 81*]

then embarrassed, and finally angry. While this is going on—the arm-grabbing bit is part of the jostling act—the wire of the troupe has arranged for a more equitable distribution of the national wealth. To add insult to injury, he may pop into the cab and order the driver to be gone from this display of ill-breeding.

The female of the species

Not all members of a pickpocket team are male. One of the smartest operations is worked in movie theaters and uses a wire and a girl stall. The wire has spotted you in the lobby buying a ticket and tucking your wallet in your back pocket. He follows you in, takes the seat directly behind you. All is peaceful for a while—he's letting you get absorbed in the film.

Now the girl enters the theater. She spots the wire and mark, and moves into your row. You're already on your feet to let her pass, but just to clinch things, when she's directly in front of you she stumbles. The diversion is perfect. The pickpocket has risen, deftly lifted your wallet, and is out of the theater while you're still apologizing.

The red-eared cop

Pocket-picking probably is as old as the first pair of pants. It was rewarded in Old England with the gallows. This not only had little deterrent effect on the practice of the art— it actually appeared to improve the pickpockets' prospects. The police authorities, in fact, suspected some members of the craft of informing on their fellows: When a hanging was scheduled, crowds would gather, and the pickpockets who had snitched enjoyed an afternoon's smörgåsbord.

But the most celebrated story in pickpocket lore, circulated among today's wires and stalls, is the one about the bookmaker who decided that the only safe way to operate outside the law was to share his profits with the captain of the police vice squad.

Still, the bookie didn't quite trust the captain. A dishonest cop might distort the facts about an honest business. So the bookie had thoughtfully taken cer-

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tain precautions before arranging a meeting at a hotel.

At the meeting, the bookie transferred to the cop an envelope containing a substantial amount of money.

Putting the money-laden envelope in his pocket, the cop announced that the bookie was under arrest for attempted bribery. He had the money, which was evidence sufficient for conviction, and two subordinate officers as witnesses.

But as cop and captive emerged from the hotel doorway, an inbound man collided with the captain of the vice squad.

When bookie and cop, flanked by the two stalwart witnesses, arrived at the precinct station, the money—the evidence—had disappeared.

Nobody knows to this day how much the bookie paid the pickpocket for the collision at the hotel door.

Protect your pockets

Either the art of pocket-picking is undergoing refinement or, with the population boom, there are just more pockets to pick these days. In New York City the post office collects an average of 450 pilfered wallets a week—discarded in mail boxes by pickpockets. Tossing a wallet into a trash basket on the street might arouse suspicion. A mailbox is closed and secretive.

The post office in Detroit finds 500 wallets a month, and when there are football games or conventions the total can run as high as 3,000 a month. Other big cities report similar figures.

You yourself don't *have* to be a victim. Take reasonable precautions. They will, at least, minimize your chances of losing your money.

- Never flash a big roll of bills or a bulging wallet.
- Carry your wallet in your inside jacket pocket. An alternative is one of your side trouser pockets.
- Be suspicious in crowds.
- If you are jostled, clap your arm to your side for the reassuring bulge of your wallet. Keep alert. If your roll is in a side trouser pocket, keep a hand in it.
- For a woman: Never allow your purse to dangle loosely. Hold it close to your body with your hand over the clasp. Never lay it down while shopping.

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SATISFACTION GUARANTEED OR YOUR MONEY BACK

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[Continued from page 207]

its top surface will bear against the inner face of the frame side above it.

2. Before covering pattern surfaces with plaster, wax all surfaces it will contact. Rub to a hard finish. Give the same areas a thin coat of oil.

3. Each mold section takes approximately 45 pounds of plaster of Paris. The stuff sets very fast, so don't try to mix it in one batch. Instead, blend the plaster and water by the pailful, adding about a quarter-pint of already-mixed casein glue to each 12-quart batch, to slow the setting action and increase the strength of the plaster. A consistency like that of heavy cream is right. Pour the first batch thinly over the pattern, watching for air bubbles and puncturing any that appear. Have the dry makings of two other batches standing by, so that you can mix and pour them in quick succession.

4. Allow the plaster to cure overnight before pulling each pattern half. If any plaster has crept around the back of the pattern, cut if off with a sharp knife first. Small imperfections are easily patched with thin plaster, carefully applied with a spatula.

Casting the fiber-glass hull. Four quarts of polyester resin and two yards of fiber-glass fabric are enough for the job. Your best buy is a fiber-glass covering kit for a 12-foot boat. These are sold by most yachting-supply stores and the leading mail-order houses. The kit costs about $18, and contains three quarts of pigmented resin, one quart of clear priming resin, enough hardener for all the resin, and a generous amount of fabric. Specify white-pigmented resin.

Prepare the mold by removing all wax and oil with turpentine, and spraying a coat of white enamel on the surface of each cavity. If you don't have a gun, use a pressurized paint. After the enamel dries, spread cold cream thinly over both surfaces, and lock the mold halves together, with the opening at the top.

Applying resin. Mix eight ounces of pigmented resin with the prescribed amount of hardener. Apply a moderately thick coat to the bottom of the cavity with a one-inch brush. Use what's left over to work up the sides of the pocket. Wash out your brush with lacquer thinner or acetone, followed by soap and water.

The resin will be hard to the touch in about 45 minutes. You can then turn the mold on its side and apply a similar coat to the upturned flank of the cavity, including the lip that will later be the sheer-line edge of the hull. Brush what's left of this eight-ounce batch of resin on the already once-coated cavity bottom. Let dry, and repeat the operation, with the mold turned over, to coat the other flank.

When you've been through this whole routine twice, you're ready to bed the fiber-glass fabric. Cut out a section somewhat larger than the hull bottom, apply a third coat of resin to the corresponding mold area, and press the fabric firmly in place with a brush. Use the eraser end of a pencil to force the cloth into the narrow quarters at bow and stern. Give the sides of the hull the same treatment. Lap the fabric at least ½″ over that on the bottom, and carry its upper edges around the lip at the sheer line, plus a few inches into the clear at the mold opening.

Follow with two more coats of resin over the fabric, applied in the same manner as the first and second on the mold. Use the clear priming resin for the last of these. Let the completed job cure for at least eight hours before you part the mold.

Pull lightly on the overhanging fabric if the hull clings to the cavities. This will ease it out readily, and you'll find yourself with a very handsome if somewhat tacky casting. Wipe the surface with a cloth dampened in lacquer thinner or acetone to clean off the cold cream. Then work the hull over with fine steel wool to give it a satiny texture. Cut off the excess fabric at the top with tin snips, and file down the sheer line.

Other materials for hull. You can make a hull for pennies by using materials more common than fiber-glass.

Brown wrapping paper, laminated with a waterproof resorcin glue, will produce a hull nearly as hard as Bakelite.

Easiest and cheapest is a hull made of layers of torn-up newspaper bonded together with water glass. Instructions for this will appear next month.

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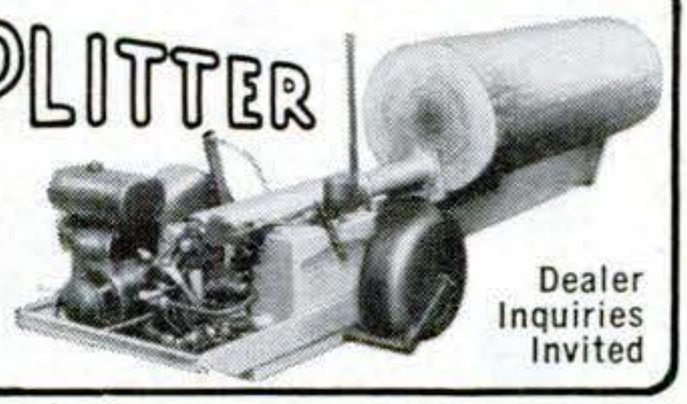

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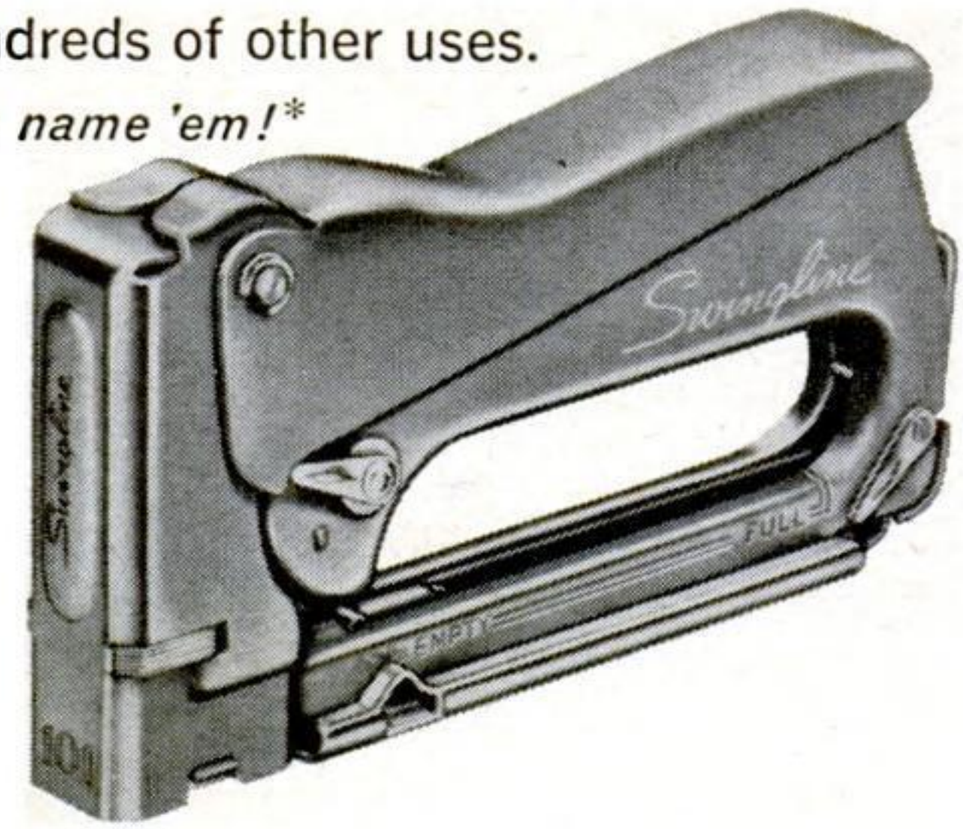

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How Good Are Those Spark-Plug Scopes?

[*Continued from page 145*]

Its trace pattern is far downfield from the other two. Here, the green wiggle finally emerges from its blunt cocoon into a mature scope trace much like the big analyzers. It shows a firing line as each plug fires, then a firing period, a diminishing wiggle as the high-voltage impulse dies, a dwell period while the points are closed, and the next firing line. Whereas Champion keeps this fascinating electronic hoopla down below the counter and displays only the firing pip, and AC subdues it to a simpler form, Autolite brings it all up on deck.

To the uninitiated, it's a bit like looking at the back of your TV set with the cover off. It all boils down to the old hi-lo game, however, as far as the voltage requirement to fire the plugs goes. If that's all you're interested in, that's all you have to look at. Autolite engineers hung a horizon across the middle of the screen and claim that their trace height is linear. In other words, according to Autolite, the trace height is not just a comparative proposition dependent on the operator's myopia, but actually measures kilovolts as truly as inches on a yardstick. To the prospective plug buyer this may not mean much, but it does serve to keep the ball in the court for the serious mechanic.

After thoroughly disposing of what to look for in the spark-plug line, the Autolite instruction manual takes up a number of unfortunate ignition conditions. Points, coil, breaker plate, unbalanced carburetion, and even an improperly set voltage regulator can be detected, according to the manual. This, of course, raises a fine line as to just how far you expect a filling-station man to go between jumps to the gas pump. Personally, I had a fascinating time playing with the Autolite scope and its basic ability seems promising.

Check your ignition? The scope analyzer I assembled from a Heathkit does, of course, all the things the others can, plus a lot they can't, and does them a lot better. But it's not an instrument for a quickie check-up while you're waiting for your green stamps. It has to be plugged in to 115 volts AC. If you want to use it away from a power outlet, you need an inverter to supply 115 volts from the car

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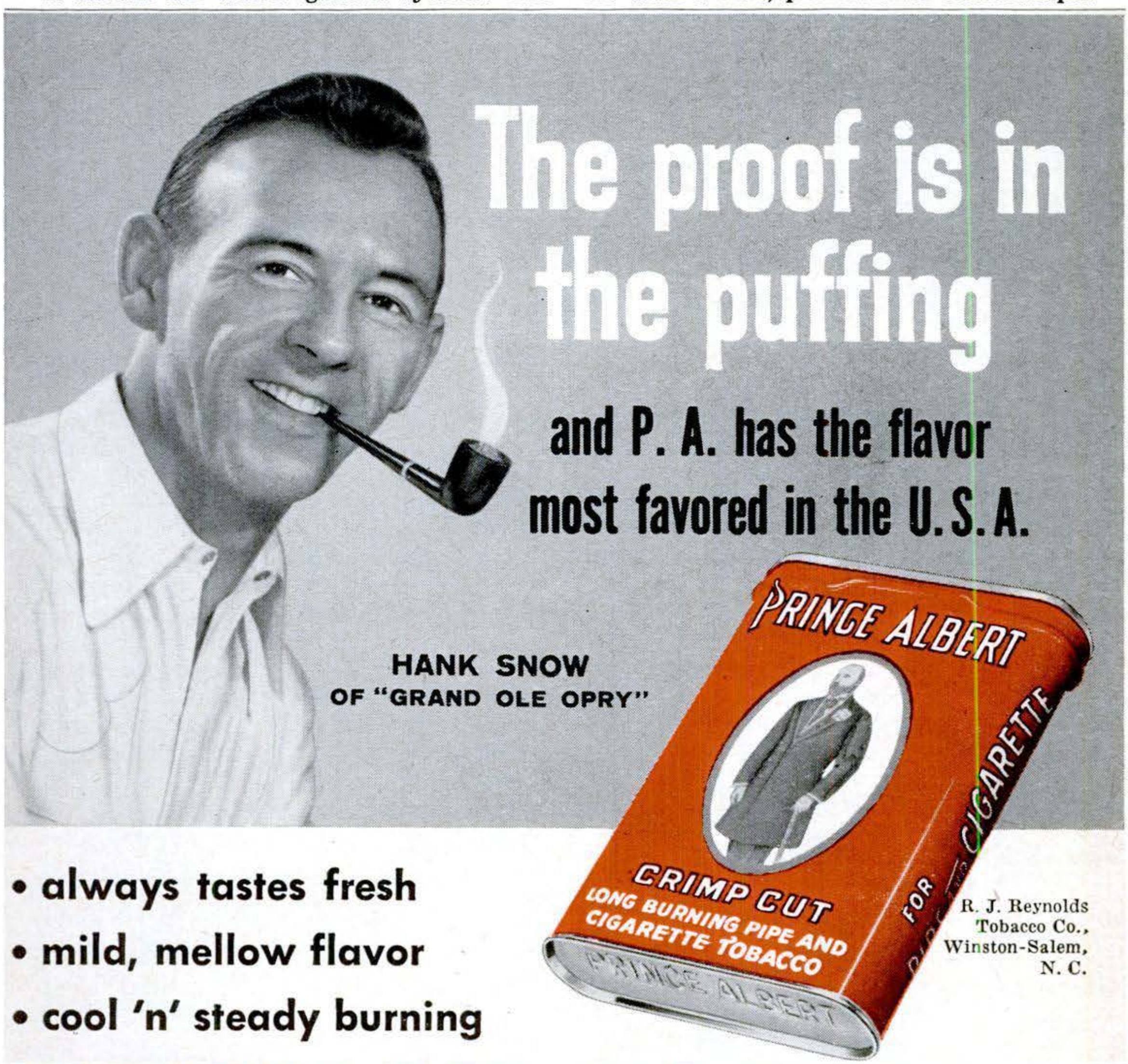
battery. The other scopes work off the car battery directly. There are enough knobs to let you set up the display to show almost any aspect of ignition-system operation. You can check out both primary and secondary systems. A single cylinder trace can be enlarged to fill the whole screen to help you pinpoint an obscure malfunction. You can also measure the dwell angle accurately while the engine is running.

Like the expensive commercial units, it checks the whole ignition system. The conclusion I reached from my tests came to this: For a quick check of your spark plugs, the AC, Autolite, and Champion scopes will usually do a good job—and, if you keep an eye on what's going on, an honest one. If you have any real doubts, drive on and try the scope at the next station. On the other hand, if a real ignition checkup is what you're after, build an analyzer and write it off in gas savings and better performance over the years, or go to an ignition tune-up specialist with a true, professional oscilloscope.



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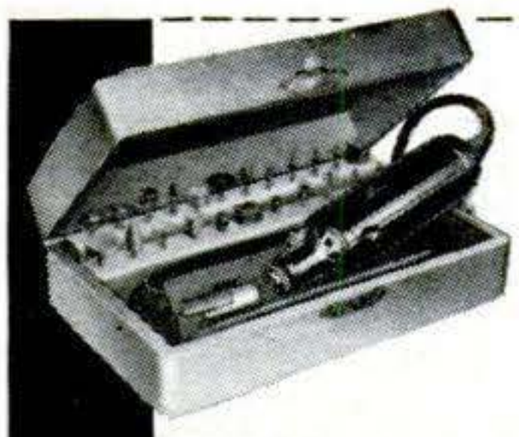

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Inside Story on the New 23-Inch TVs

[*Continued from page 86*]

new square-cornered screen. It was a couple of things all fitting neatly together. The idea didn't even come from TV makers, but from a glass outfit.

The venerable Corning Glass Works, famous for 39¢ Pyrex pans and $4,000 Steuben bowls, earns most of its dividends making bulbs for TV picture tubes.

Corning had problems. It told Research: Make a more attractive screen—squarer shape, new size—to hypo TV-set sales, which had slackened off and hurt the bulb business. Make the new bulb of thinner glass, so that the electronics people can process it more easily. (Thinner glass speeds up heat treatment of a tube.) Build in the safety shield, so that Corning can sell that hunk of glass, too (the separate shields are made by Pittsburgh Plate, a fact that pained Corning greatly).

A solution to the last problem would automatically solve the first two: A safety shield that caps the face of the tube reinforces it. This makes up for strength lost by thinning the glass and squaring its shape. But the lab men's first try flopped. They welded a cap over the tube, filling the space between with special oil. TV makers wouldn't buy that (for fear the oil might leak).

See-through cement. Back to the lab went the researchers. This time they got Dow Chemical to concoct an epoxy cement—very tricky, since it had to be optically clear. That did it. Now the tube makers could cement on the safety cap, in their own factories, after they had taken advantage of the fast processing that thin bulbs permitted.

The bonded safety shield has not caught on so well in the 19-inch size because of its weight. The 19-inchers are intended to be portables, or at least liftables, and many makers save pounds by using separate plastic (not glass) safety shields.

The success of the new square-cornered TV screen—of whatever version—is obvious from the POPULAR SCIENCE specification chart. Last year's chart listed three. This year everybody has them. The 21-inchers remaining are mostly holdovers (you'll get good discounts on them, and their electronic chassis are usually identical with the 23s).

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Answers to PS Puzzlers on 32 and 45

Stock-splitting: Dad threw in a share of his own, making a total of 18. Then Harry got half—9; Tom one-third—6; and David one-ninth—2. So everyone was happy—9 + 6 + 2 = 17—and Dad got his share back again.

The murder cast: The five statements tell us:

1. McFee is not the victim or the murderer.
2. The judge is not Clayton.
3. Warren is either the hangman or the murderer.
4. The policeman is not Graham.
5. Either Holgate or Warren is the victim.

(The victim is the only person who might not be seen by the other five.)

Putting 3 and 5 together, it's clear that Holgate is the victim. This forces Warren to be the hangman and Forbes to be the murderer. Now what about the others? The judge is either McFee or Graham. But he can't be Graham if the policeman found Graham near the body. (He obviously could not act as judge in a case where he figures as a witness.) So the judge is McFee. This forces the policeman to be Clayton and the witness Graham.

Fencing problem:

No-hands jar: Remember the old burning trick with the magnifying glass? Yup. Focus the sun's rays on the thread where it's tied to the plumb bob. A few minutes ought to sizzle it nicely.

Note: Remember the October P-O-T-M about track and field events? We assumed complete freedom about scoring, but at least one reader didn't. William Hellings of Newport Beach, Calif., came up with an ingenious solution that conforms with official track-meet rules: 5 points for first place, 3 for second, 1 for third, 0 for fouls, ties for second scored 2-2. He has A winning four events, tieing in one; B winning one event, tieing in two, fouling in two; and C tieing in three, fouling in one, and taking second in the hundred-yard dash —that last fact nicely agreeing with the original solution given in November PS.

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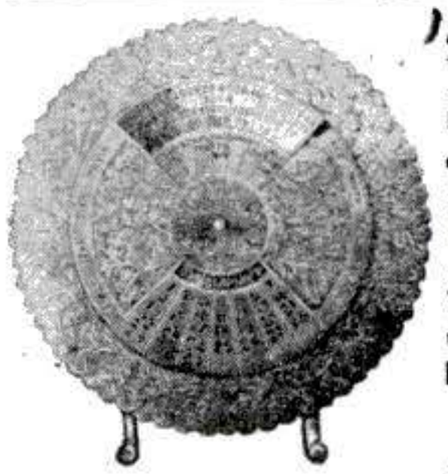

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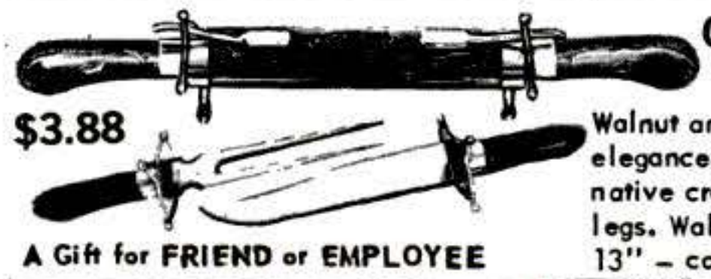

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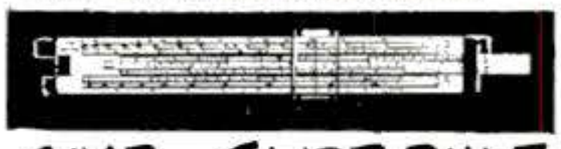

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[Continued from page 100]

elegance in appearance. These attributes cost money, of course ($1,381 f.o.b. N.Y.).

Flexibility. The ability to go from a low speed to a high one, or vice versa, without having to shift gears is one of the R-69's most endearing traits. It not only cuts acceleration time (zero to 60 m.p.h. in first and second gear takes about eight seconds), but makes driving in traffic or on twisty roads painless. In third gear, for example, you can drop down to 15 m.p.h. when traffic slows or just before you enter a sharp curve, then pour on the coal and zip smoothly up to any legal speed limit.

To prove its reliability, John Penton, a 33-year-old Lorain, Ohio, BMW dealer, set a new coast-to-coast motorcycle record on an R-69 in June 1959. Penton covered 3,051 miles from New York to Los Angeles in 52 hours and 11 minutes. Despite a 58-m.p.h. average speed, the machine came through fine. A trace of oil on the top of the crankcase and a rough-acting front brake were the only signs of her grueling trip. Such durability came as no surprise to other BMW owners, who say that it begins to break in only after the first 6,000 miles.

The remarkable brakes. These and the cleverly engineered suspension are a match for the 35-hp. engine. Most of the stopping power is in the massive front brake, a twin-leading-shoe type designed for racing machines. Both shoes are arranged so that their leading edges meet the spinning brake drum first. There is a self-energizing action, as the drum tends to pull the shoes against itself. (Usually brakes have one leading, one trailing shoe.) A harder-than-normal brake-lining material prevents the front wheel from locking, even in a panic stop.

The rear wheel is suspended between two swinging arms—tubes that pivot in bearings on the aftermost vertical frame members. Hydraulic shock absorbers dampen the wheel's bouncing.

An Earles-type fork (invented in England) suspends the front wheel. Again, a pair of swinging arms pivoted in bearings let the wheel move up and down against the damping effect of hydraulic shocks. This bottom-link type of front fork does more than hold the wheel steady and firmly on the ground. When the front brake is clamped on hard, the front end stays level or, if anything, rises slightly instead of diving. The Earles fork converts the weight transferred forward during braking into a force that levers up the front end through the swinging arms. Result: first-rate control.

A smooth ride. Fitted with a molded-rubber solo saddle that pivots at its front edge against spring tension, the BMW is the most comfortable cycle going.

Unhappily, my test machine had the more common dual seat—a firm, too-wide pillow rigidly fastened to the rear fender and the tank. Though adequate, the dual seat did little to smooth out the occasional jolts that got past the excellent suspension.

The bike's long wheelbase (the R-69 measures almost seven foot overall) adds to comfort, especially on trips, by smoothing out undulations in the road surface.

There were other things I liked about the BMW—like the 90-watt high beam of its headlight. Not only did it spread over four lanes for as far as a car's lights, but it also threw a welcome crescent of light forward of the front fender to light the road immediately ahead.

Like any vehicle, the R-69 has its faults. Most serious is the unhappy position of the air-induction pipe to the right-hand cylinder. This passes directly above the rear-brake pedal, getting in the way of your ankle if you try to exert pressure with the entire leg. If the front brake were not so outstanding, this difficulty in applying the rear one would be serious.

Complaint department. By comparison, other faults are minor. Careful muffling has made the BMW the quietest big motorcycle on the road today, but it still has the noisiest gearbox. Each flip of the gear-change lever produces a *clunk* audible across the street. And the single-plate dry clutch has a sudden bite that makes shifting an adventure for the inexperienced. A brighter bulb in the speedometer head would also be welcome at night.

But these are quibbles. The BMW R-69 is about as distinguished, in performance and appearance, as a motorcycle can get.

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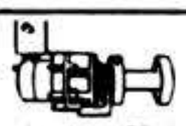

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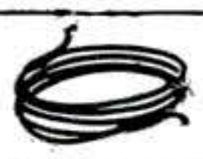

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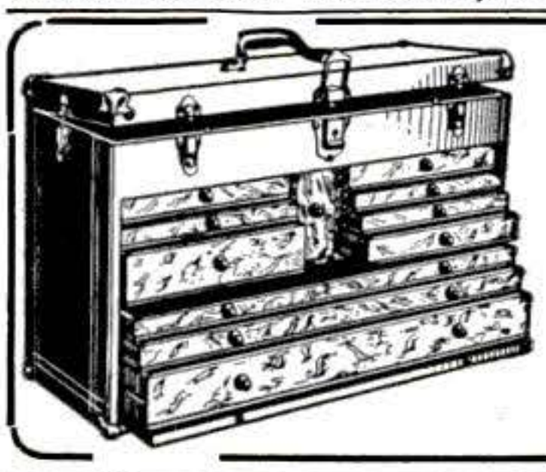

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[Continued from page 129]

ing can now be done about it. Thus we have the anachronism that Jesus was born sometime in the period that is called Before Christ. And the actual month and day is even more hopelessly obscure, for December 25 was not celebrated as Christmas until the fourth century, long after the real date was forgotten.)

A possibility that has received serious consideration is that the star of Bethlehem was produced by two planets coming so close together that to weak eyes their light might have seemed to come from a single star. In astronomical language, they were in conjunction. If it could be shown that an unusually close conjunction occurred at about the right time, the coincidence would be very striking, to say the least. Several attempts have been made to establish the date of the true Annus Domini by this means.

Tracking the planets. Now when the positions of the planets are traced back to the time of Christ, it is found that Jupiter and Saturn were in conjunction three times in the year 7 B.C. This discovery was made over a century ago by the German chronologist C. L. Ideler. According to him, the first conjunction would appear as the sign for which the Magi had been waiting, and would have started them on their journey to Jerusalem. The last conjunction was so close that the two planets might have appeared merged into one, and would also have been in the proper position in the sky to have led the Magi from Jerusalem to Bethlehem. Ideler believed that these conjunctions satisfied the conditions regarding the star of Bethlehem so well that they established the time of the birth of Christ as 7 B.C.

In 1856 the Rev. Charles Pritchard, a clergyman and professor of astronomy who did important work on the distances of the stars, made a careful check on Ideler's conclusions. He found that while there were three conjunctions of Jupiter and Saturn in 7 B.C., they did not occur at the times given by Ideler. He found also that the two planets were never closer than twice the diameter of the full moon, and so could not possibly have been mistaken for one. Pritchard's calculations were confirmed independently by the Greenwich Observatory, and there seems to be no reason to doubt their correctness. Thus the hypothesis of a close conjunction, although ingenious, is capable of being mathematically tested and is found definitely wrong.

Let us now consider an entirely different object that might explain the star.

Sifting the stars. One may scan the heavens for years and never see anything that has not been seen before. But tomorrow night an amateur astronomer looking at the Milky Way may see a star as bright as Venus blazing where no star of that size has any right to be. Such new stars are called novae, and although they seldom become this conspicuous, there are a few that have attained great brilliance. The brightest on record appeared in 1572 and was more brilliant than Venus. Another, in 1604, was almost as bright. Both were carefully studied, the first by the Danish astronomer Tycho Brahe and the second by his pupil Kepler.

A nova may maintain its extraordinary brilliance for a few days; but then it begins to fade, and although there may be minor flare-ups, it never regains its original brightness.

It is, of course, impossible to say whether or not the star of Bethlehem was a nova, but there are several reasons why such a supposition seems fairly plausible. In the first place, a nova would easily account for the great brilliance of the star. Second, a new star of this kind would be regarded as a sign of supernatural origin that could not fail to be heeded by everyone. Finally, the nova would have remained conspicuous long enough for the Magi to have completed their journey before it faded from sight, which would explain why it was never mentioned later. Against the idea of a nova is the fact that there is no independent record of a bright new star having been observed by other people, such as the Chinese or Japanese. It seems impossible that they could have missed such a spectacular object.

Fireballs in space. Still another explanation that remains to be considered makes a stronger appeal to the imagination than any of those already mentioned. The star might have been Halley's comet.

Edmund Halley was the 17th century

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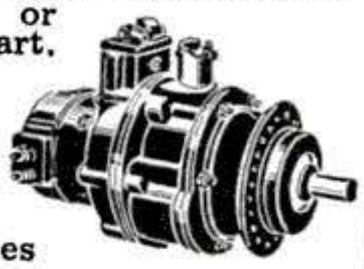

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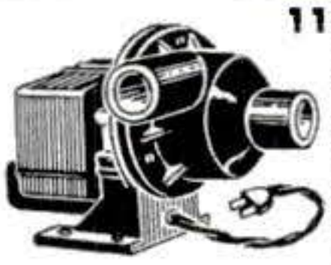

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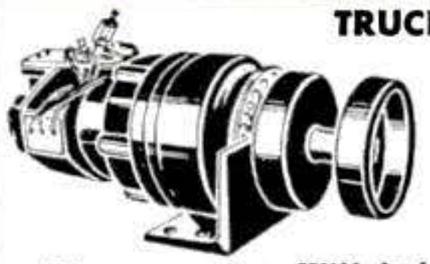

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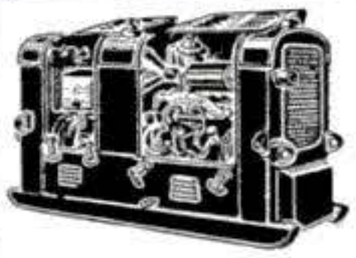

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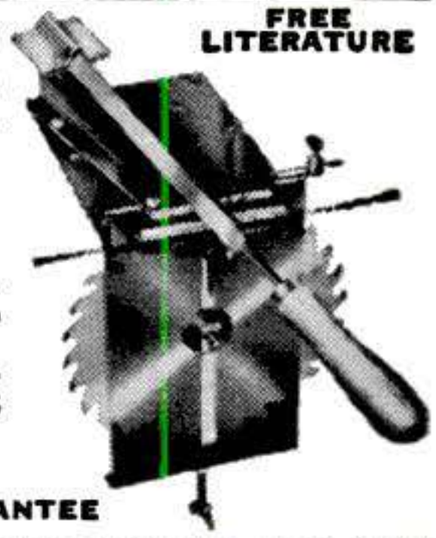

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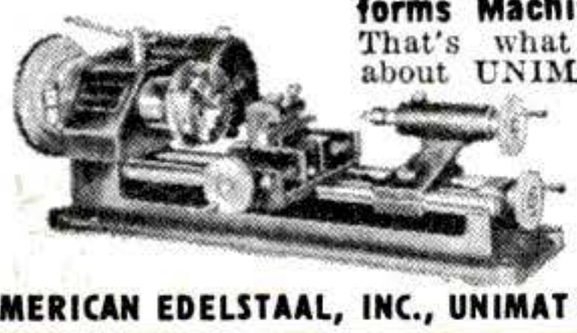

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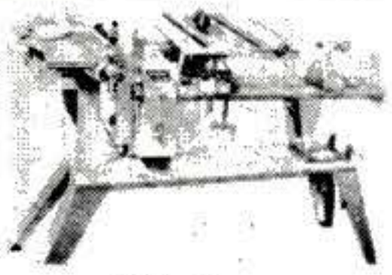
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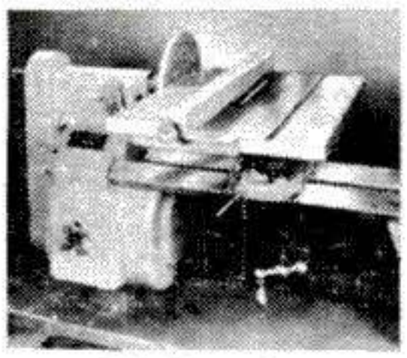
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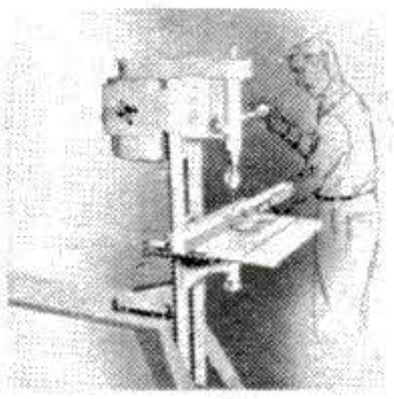
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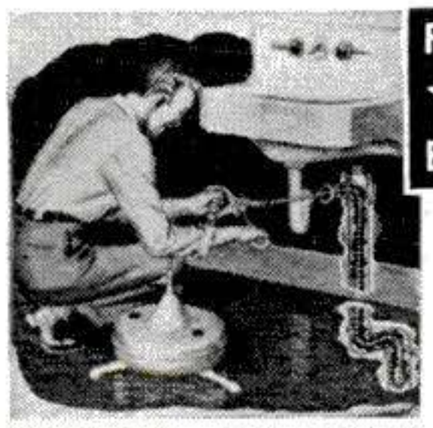

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What Was the Star of Bethlehem?

astronomer who first plotted the comet's orbit and predicted its returns at intervals of 75 or 76 years. Comets are huge balls—bigger than Earth—of almost empty space that are visible only when they near the sun. Then the dust and gas particles that make them up shine brilliantly, and the gases, sun-heated as well, stream out to form the comet's tail.

An extensive search of old chronicles reveals the definite record of a comet at the proper season and in the right part of the sky for every one of the 27 times that Halley's comet has visited the earth between 87 B.C. and A.D. 1910. One of the earliest, and at the same time one of the most certain, returns of the comet was in 11 B.C. As stated before, the date of the birth of Christ is not known, except that it was probably about 5 B.C. Although this is six years after the appearance of the comet, history is so indefinite that the interval does not seem overly long. A bright comet could not fail to arouse universal wonder.

The path of the comet. But there is another scrap of evidence that makes the visit of 11 B.C. of peculiar interest. During the latter part of August of that year, it is recorded that Halley's comet was in the constellation of Gemini, the twins, a little north of the two bright stars Castor and Pollux. The latitude of Bethlehem is 31 degrees 42 minutes, and it so happens that 2,000 years ago Castor and Pollux were almost exactly 31 degrees 42 minutes north of what astronomers call the celestial equator. This means that Castor and Pollux, in their daily journey across the celestial sphere, passed through the zenith of Bethlehem. And since Halley's comet came very close to Castor and Pollux, it must also at one time have stood directly over Bethlehem—"the place where the young child was."

Thus astronomers can scarcely be accused of making no effort to solve the problem, for they have at least investigated the possibility of a celestial object having been directly over Bethlehem, at about the time historians give for the birth of Christ. Just how it could have pointed out the right dwelling to the Magi is still a mystery, but perhaps it is better that some questions remain unanswered. The story has endured for 2,000 years because of its beauty and simplicity.

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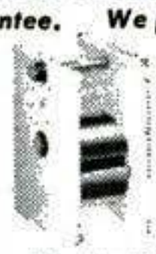

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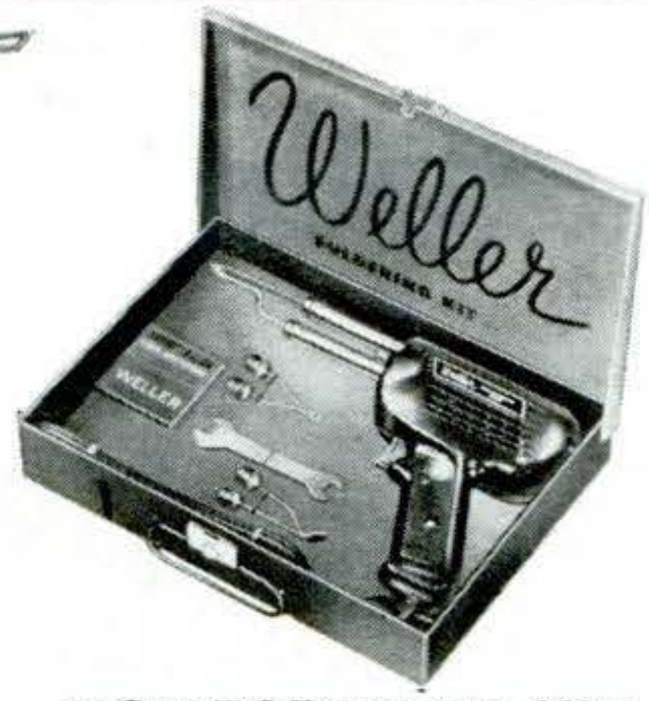

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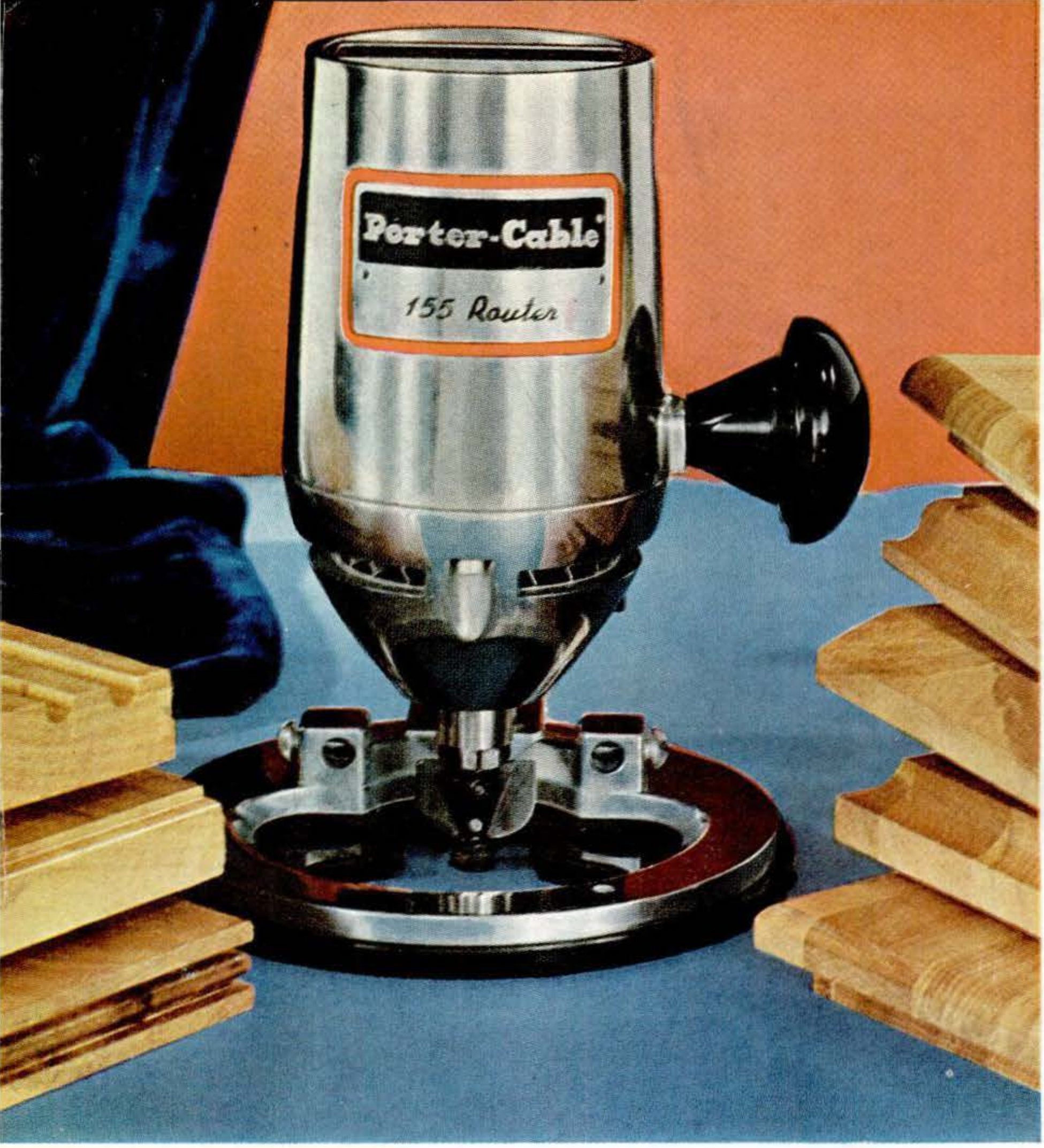

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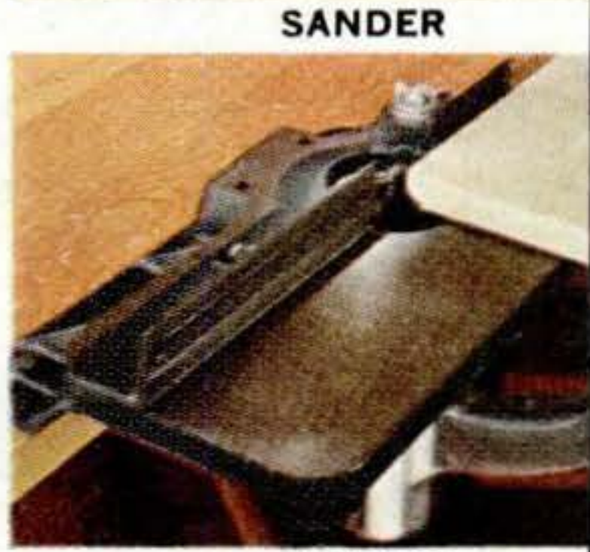

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